

REPORT DOCUMENTATION PAGE**Form Approved**
OMB No. 0704-0188

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1. REPORT DATE (DD-MM-YYYY) 03-05-2011		2. REPORT TYPE Master of Military Studies Research Paper		3. DATES COVERED (From - To) September 2010 - May 2011	
4. TITLE AND SUBTITLE Who's Their Daddy? The Marine Corps unmanned community lacks a dedicated senior organizational advocate who can best shape a long-term vision to support the future MAGTF				5a. CONTRACT NUMBER N/A	
				5b. GRANT NUMBER N/A	
				5c. PROGRAM ELEMENT NUMBER N/A	
6. AUTHOR(S) Major Ryan "Puddy" Hough				5d. PROJECT NUMBER N/A	
				5e. TASK NUMBER N/A	
				5f. WORK UNIT NUMBER N/A	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) USMC Command and Staff College Marine Corps University 2076 South Street Quantico, VA 22134-5068				8. PERFORMING ORGANIZATION REPORT NUMBER N/A	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A				10. SPONSOR/MONITOR'S ACRONYM(S) N/A	
				11. SPONSORING/MONITORING AGENCY REPORT NUMBER N/A	
12. DISTRIBUTION AVAILABILITY STATEMENT Unlimited					
13. SUPPLEMENTARY NOTES N/A					
14. ABSTRACT Marine Unmanned Groups (MUG) are needed to provide the senior advocacy to guide the doctrine, vision, operating concepts and requirements for future unmanned systems in order to best support the Marine Air-Ground Task Force (MAGTF) of the future.					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON Marine Corps University / Command and Staff College
a. REPORT Unclass	b. ABSTRACT Unclass	c. THIS PAGE Unclass			19b. TELEPHONE NUMBER (Include area code) (703) 784-3330 (Admin Office)

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*United States Marine Corps
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MASTER OF MILITARY STUDIES

Who's Their Daddy?

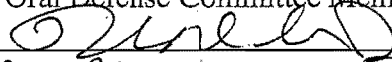
The Marine Corps unmanned community lacks a dedicated senior organizational advocate who can best shape a long-term vision to support the future MAGTF

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES

MAJOR RYAN P. HOUGH, UNITED STATES MARINE CORPS

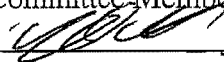
AY 10-11

Mentor and Oral Defense Committee Member: Dr. Paul D. GALT

Approved: 

Date: 3 May 2011

Oral Defense Committee Member: Dr Douglas E. Streng

Approved: 

Date: 3 May 2011

EXECUTIVE SUMMARY

Title: Who's Their Daddy? The Marine Corps unmanned community lacks a dedicated senior organizational advocate who can best shape a long-term vision to support the future MAGTF

Author: Major Ryan P. Hough, USMC

Thesis: Marine Unmanned Groups (MUG) are needed to provide the senior advocacy to guide the doctrine, vision, operating concepts and requirements for future unmanned systems in order to best support the Marine Air-Ground Task Force of the future.

Discussion: The results of the Force Structure Review in March 2011, recommends a 7% reduction of overall active duty Marine manpower after combat operations in Afghanistan come to an end. However, several key communities, to include special operations (44% increase), cyber network defense and unmanned aircraft squadrons (25% increase), will expand to help tailor the Marine Corps for the expected asymmetric threats of the future.

Simply expanding the unmanned community will not adequately address the challenges of integrating future weaponized unmanned aircraft. The Marine Corps began developing concepts for unmanned systems as early as 1954. Since the first unmanned units were established in 1984, their role and organizational structure has been continually debated as they have moved among the Artillery Regiment (1984-1987), Surveillance, Reconnaissance, Intelligence Group (1987-1996), Marine Aircraft Group (1996-2000) and finally, the Marine Air Control Group (2000-present). In the last ten years of combat, unmanned aircraft systems, led by capable aviators, have steadily increased their capability and proportional support to the Marine Air-Ground Task Force. In the years ahead, Marine UAS will be capable of conducting at least five, and possibly all, of the six core functions of Marine Aviation. Intelligence and operational utility in Iraq and Afghanistan have shown that the UAS has become a necessity for ground commanders. The role of the UAS will continue to grow through field experience, ingenuity and advances in technology, and certainly will become more prevalent in the future. Marine UAS, integrated as part of the Marine single-battle concept, has the potential to become the most capable fires platform available for Marine ground commanders. If the Marine Corps is not willing to take the necessary steps today to make its UAS the best assets to support the Marine Air-Ground Task Force, there is a danger that shrinking defense budgets will mandate the reliance on other Services to provide armed unmanned support for Marine ground units in the future.

While Marine unmanned aircraft have flourished under the Marine Air Control Group, their subsequent arming with air to ground ordnance suggests relocation to a more fires-minded organization. Some argue that the natural home would be to return the Marine Unmanned Aerial Squadrons to the Marine Aircraft Groups. Being co-located with other fires, EW, and assault support platforms would provide multiple benefits including allowing the new UAS military occupational specialty, due to start in 2012, to continue to mature amongst other aviation programs as well as force integration between manned and unmanned platforms. The reality is that aircraft groups are mostly community specific organizations with O-6 advocates setting requirement and priorities through yearly Operational Advisory Groups in the communities they have spent their careers serving. Even in composite aircraft groups, such as MAG-14, over 90% of the training is internal to the type/model/series aircraft squadrons, with little devoted to

integration among neighbor platforms. Inevitably, this territorial approach will stunt the long-term vision of a fast growing technological unmanned community.

Only with the development of dedicated Marine Unmanned Groups can the unmanned community reach its full potential. The eventual fielding of large, armed, Group 4 UAS capable of a 1350nm radius and ten hours time on station will demand a much different focus than the small tactical UAS detachments, or the cargo UAS being fielded for proof of concept in August, 2011. Through planned manpower consolidation savings achieved in the re-structuring of the STOVL community, additional manpower may be available to split the VMU into specific attack, observation and cargo squadrons. In addition to the unmanned group, the creation of a UAS Department at Marine Aviation Weapons and Tactics Squadron – One, populated with experienced intelligence officers, assault support, and fires oriented aviators (eventually seasoned UAS officers) will build a base of knowledge able to write sound tactical manuals and will quickly advance standardized tactics, techniques and procedures (TTP). The outcomes will be strategically relevant --limited only by ingenuity. By training enlisted UAS operators to become Joint Terminal Attack Controllers (JTAC) and serve ground tours with the new artillery fires platoons, the unmanned community will become a balanced fires community in its own right. Unmanned systems, with persuasive leadership and an effective organizational structure, will become the most integrated combined arms, multi-role platforms within the Marine Corps.

Conclusion: In order for Marine aviation to best support the “middle-weight fighter” on the ground, the current and emerging lethal capabilities of unmanned platforms demand a departure from the current organizational structure. The establishment of Marine Unmanned Groups will best support the development of doctrine, vision, operating concepts and requirements (e.g. funding) to best support the MAGTF in the future.

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THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY REPRESENT THE VIEWS OF EITHER THE MARINE CORPS COMMAND AND STAFF COLLEGE OR ANY OTHER GOVERNMENT AGENCY. REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING STATEMENT.

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Preface

I have spent 95% of my aviation combat tours simulating unmanned aircraft by using my targeting pod to conduct what has been coined “non-traditional intelligence, surveillance and reconnaissance (NTISR),” and 90% of my Air Officer tour trying to get the persistent ISR capability of unmanned aircraft before, during, and after combat missions.

As an aviator, I have witnessed my AV-8B *Harrier* community deteriorate in Low Altitude Tactics (LAT), Armed Interdiction (AI), Strike Coordination and Reconnaissance (SCAR), Air Combat Maneuvers (ACM) and Basic Fighter Maneuvers (BFM) skills while training and then deploying to combat to provide mostly NTISR. This is not to say that Marine TacAir should not be supporting the Ground Combat Element (GCE) in today’s current fight. Rather, it is recognition that we cannot sustain a reliance on fuel-thirsty, expensive, high performance jet aircraft to do a job a much less costly unmanned aircraft can do as well or better.

Until my Air Officer tour in Afghanistan, I had no previous experience with Marine unmanned squadrons. I viewed them as a sideshow and a nuisance when trying to employ ordnance. That viewpoint changed dramatically after serving on the ground in 2010 from a remote firebase in the Morghab River Valley. On one particular mission, I consciously chose two armed USAF unmanned aircraft, which had a combined nineteen hours on station, two five-hundred pound bombs and five air-to-ground missiles, as my primary Close Air Support (CAS) platforms instead of the manned platforms also on station. Over the course of the twenty-four hour operation the ten fighter/attack and bomber platforms assumed a secondary role scanning outside the unmanned systems’ field of view. When enemy forces attempted to flank us, the *Reaper* gained positive identification (PID), transmitted the feed to the strike approval authority (battalion commander over 180km away) and successfully conducted multiple strikes near

civilian compounds with low collateral damage missiles.

The above experience is just one instance that highlights the growing role and utility of unmanned aircraft. The bias and misunderstanding I had for unmanned aircraft is still widespread throughout the aviation community. After six months of study and research, I have concluded that many in Marine Aviation recognize the growing role of UAS, but few appreciate just how quickly and to what extent they will need to be employed to support the MAGTF in the future.

I am grateful to have had the opportunity to spend the past year attending USMC Command and Staff College and working closely with my thesis mentor, Dr. Paul Gelpi. The luxury of having time to study, discuss and give thought to problems facing our Marine Corps has been personally and professionally rewarding. As military deployments have increased for most Marines over the last decade, I have appreciated a year to study and spend quality time with my family.

I would also like to acknowledge that this paper would not have been possible without the help from many current and former Marines. Interviews, phone calls and numerous email queries were patiently answered as I attempted to fully understand the problems facing the VMU community. I would especially like to thank Lieutenant General Hough; Colonels Werth, Nelson, Hardison and Powers and Lieutenant Colonels Beach, Wirth, Huber, Frey and Williams. Without their insight and perspective I would not have been able to understand the subject. Lastly, I would like to thank my dad, John Hough, who provided countless patient hours of editing while attempting to make this paper understandable to those outside the Marine aviation community.

NOTE: The term UAS in this paper refers to systems categorized as Group 3 (see *Appendix B* for definition) or larger.

To remain the Nation's force in readiness, the Marine Corps must continuously innovate. This requires that we look across the entire institution and identify areas that need improvement and effect positive change.

- *Marine Corps Vision and Strategy 2025*

The use of unmanned systems in the future will only be limited by imagination. Growth in technology and the use of unmanned aircraft in the latter part of the century (20th) will be tenfold.

- Major L. R. Fuchs, *Marine Corps Gazette* (1981)

Introduction

Marine unmanned aircraft have proven a proven track record supporting the Marine Air-Ground Task Force (MAGTF) for nearly three decades. Recent conflicts in Iraq and Afghanistan, coupled with the rapid development in robotic technology, has changed the role of unmanned aircraft from traditional intelligence, surveillance and reconnaissance (ISR) platforms to capable multi-role weaponized platforms, able to find, fix and finish enemy forces. The advances being seen on the battlefield today are largely the result tactical ingenuity from capable operators, not from the fulfillment of a long-term vision. In order to fully harness the potential of unmanned aircraft systems (UAS) in the Marine Corps, we must design and fully staff a Marine Unmanned Group (MUG). The MUG, capable of developing the vision and operating concepts of an increasing unmanned community, is necessary to advocate for the right requirements to exploit the promising future of the UAS to best support future MAGTFs. This thesis will present what the future of Marine Corps UAS command structure should be based on: lessons learned from UAS history, current force structure, expected growth and increasing demand for capable weaponized ISR systems.

Marjah, 2010

On February 10, 2010, the 7th Marine Regiment moved its battalions into attack positions for its largest operation to date in the war in Afghanistan. As the operation began to unfold, 1st

Battalion, 6th Marines (1/6), attached to the 7th Marine Regimental Combat Team (RCT-7), lost satellite communication (SATCOM) with their higher headquarters as they moved outside the southern Afghan city of Marjah. The Marines, expecting fierce fighting, immediately came under simultaneous attack from three sides.

The only external asset that had radio communication with the Marines was the small RQ-7B "*Shadow*" unmanned aircraft flown by a Marine Unmanned Aerial Vehicle Squadron (VMU) out of the main Marine base in Helmand Province, Camp Dwyer. The *Shadow*, monitoring the situation from above, was able to provide situational awareness by passing the coordinates of one enemy position and providing effective adjustments to the Marines for their organic direct fire weapons on the other two positions.¹ As this occurred, the battalion Air Officer made repeated attempts to establish external communication and declare "Troops in Contact" (TIC) in order to receive immediate close air support (CAS).²

Unable to reach higher headquarters on SATCOM, the Air Officer relied on the unmanned *Shadow* overhead to make his urgent CAS request. After successfully redirecting an Air Force unmanned MQ-1 *Predator*, the *Shadow* crew then provided communication relay between the FAC and the armed unmanned aircraft. The *Shadow* crew, acting on their own initiative, passed accurate coordinates of the remaining enemy fighting position to the *Predator* crew located 8,000 miles away at Creech Air Force Base in Nevada. Inside the VMU Combat Operations Center (COC) the *Shadow* mission commander, using a real-time video enhanced receiver, was able to view the *Predator*'s video feed on a high-definition forty-two inch screen and refine the target location.

After the VMU mission commander pushed the *Predator* and FAC through three different frequencies, direct radio communication was finally established. By time the *Predator*

had received its attack brief however, the enemy fighters had dropped their weapons and disappeared into a nearby compound where positive identification was lost, preventing a strike. No longer able to deliver ordnance due to the rules of engagement, the *Predator* provided over watch for the remainder of its time on station.³

The situation described above, while not a complete success, does demonstrate the evolving nature and potential of Marine unmanned systems. Within the next twelve to eighteen months, the Marine Corps will begin arming the *Shadow* tactical Marine UAS (as well as more capable follow on systems) that will make it unnecessary to wait for another platform to check on station, correlate and then attack a target.⁴ In effect, Marine unmanned platforms will facilitate all four steps within the Observe, Orient, Decide and Act (OODA) Loop, significantly shortening the length of the kill chain, increasing the lethality against time fleeting targets, and decreasing the reliance on other Services' unmanned platforms.⁵

The ability of a tactical Marine UAS to perform the intelligence collection leading up the operation and then conduct all the air coordination for a battalion on the move is remarkable. The vignette however only demonstrates a fraction of the integration being achieved by Marine VMU squadrons co-located with their supported ground units in Afghanistan and controlled by a competent fires oriented crew. On other occasions, the *Shadow* was able to rewind and freeze video images from a weapons attack, match it up with other imagery, and provide immediate, high fidelity, battle damage assessment (BDA) before the FAC or aircrew knew the outcome. This integration, with tactical UAS providing pre-mission pattern of life, positive identification, target attack, and battle damage assessment has the potential to make Marine armed UAS the most capable asset for the predicted low intensity conflicts of the future.

The VMU-3 Commanding Officer, and mission commander during the above vignette, Lieutenant Colonel James "Chewy" Frey, is convinced that the role of Marine UAS will only continue to grow. Frey, speaking about his coordination with other aircraft and the ground forces, stated that;

Backed up by *Shadow*, we maintain PID, can shift the targeting pod, provide an infrared mark, laser mark, or derive (highly accurate) CAT II target location error (TLE) coordinates for JDAM (GPS guided bombs), HIMARS (GPS guided high mobility artillery rocket system), Excalibur (GPS guided artillery shells), or just a bomb (non-precision). It's amazing and only limited by imagination. The imagination is the result of having a TACAIR (fighter/attack community) FAC (Airborne) and Tactical Air Controller (Airborne) background for the first time in the (UAS) community.⁶

Frey also told then Assistant Commandant of the Marine Corps, General James F. Amos that his VMU, if armed, would have killed more enemy fighters than the entire Marine Air Combat Element (ACE) combined. This claim is not far-fetched. The squadron flew thousands of hours where it often observed enemy fighters emplacing roadside bombs, setting ambushes and maneuvering on Marine forces. The rapidly emerging capabilities of Marine UAS, to include delivery of aviation ordnance, demands the supervision and leadership of a dedicated advocate in a flying oriented Group.

-How Did We Get Here?

By historical standards, the modern battlefield is particularly disorderly. While past battlefields could be described by linear formations and uninterrupted linear fronts, we cannot think of today's battlefield in linear terms.
- MCWP-1 *Warfighting* (1997)

- "As you know, you go to war with the Army you have. They're not the Army you might want or wish to have at a later time."

- Donald Rumsfeld, Former Secretary of Defense

The Marine Corps has been developing operational concepts for unmanned systems since 1954 when the Commandant directed the Marine Corps Development Center to study the

requirements for a remote controlled rotary winged aircraft.⁷ The Marine Aviation Program for 1959-1964 changed in 1960 to include the creation of one unmanned helicopter squadron in 1963 followed by two more in 1964 for unmanned resupply to remote combat outposts.⁸ Although cancelled in 1963 due to cost and reliability issues the concept has remained relevant as the Marine Corps prepares to operationally test an unmanned cargo resupply in Afghanistan this August.⁹

In 1966, another program code-named "Bikini," was tested by the 2nd Reconnaissance Battalion for a period of one year. The remote control drones allowed the ground commander to obtain battlefield photographs in less than one hour compared to the six to eight hour lag from manned aerial reconnaissance. Unfortunately, the capability was not sustainable. Seventy-percent of the aircraft crashed during the three-hundred and twenty seven missions conducted in the first year forcing cancellation of the program.¹⁰ Less than twenty years later, in 1984, two US Navy aircraft were shot down attempting to gather reconnaissance imagery in Lebanon. Secretary of the Navy, John F. Lehman, Jr. concluded that relatively cheap and reliable unmanned vehicles flown by Israel could have accomplished the task without endangering Americans and promptly purchased the Mastiff unmanned system for the Navy and Marine Corps.¹¹

Since 1984, Marine unmanned units have fallen under four distinctly different command organizations as the Marine Corps has struggled to find the right advocate who could effectively operate the platforms and provide timely support to ground forces. Initially, the artillery regiment used the unmanned systems for target spotting and call for fire. In 1987, the Marine Corps acquired the newer RQ-2 Pioneer UAS and moved the system to the Surveillance,

Reconnaissance, Intelligence Group (SRIG) to conduct a similar mission as the original Bikini project, providing timely battlefield intelligence, surveillance and reconnaissance (ISR).¹²

Within the SRIG the Pioneer system deployed and flew more than nine-hundred hours in support of Operations Desert Shield and Desert Storm as well as providing reconnaissance during Operation Provide Comfort in northern Iraq and Operation Joint Endeavour in the Balkans. Unfortunately, mishaps that plagued the Bikini program in the 1960s had not been resolved thirty years later. In just eight years while flying the Pioneer, the USMC crashed 36 vehicles in 5,000 flight hours.¹³ The mishaps, along with the poor aircraft availability resulted in the transfer and re-designation of the UAV companies to Marine Aircraft Groups in 1996 as VMUs. Four years later in 2000, the Deputy Commandant for Aviation, General Nyland, reassigned both VMU squadrons to their current home under the Marine Air Control Groups (MACG).¹⁴

What It Looks Like Today

During its almost thirty-year history, the MACG has provided the longest period of stability for the Marine Corps unmanned systems. The inherent aviation command and control (C2) capabilities of the Control Group, the placement of aviators as commanding officers and mission commanders, significant leaps in technology (to include the upgrade to the RQ-7B *Shadow*) and almost a decade of combat has allowed the VMU to make huge strides in capability and application.¹⁵

From the start of Operation Iraqi Freedom (OIF), the Pioneer system within the VMU steadily increased its capability. With the VMU consisting of a single system (comprised of eight twenty year old Pioneer planes and two ground control station GCS), it was constantly moving from various forward operating bases throughout Iraq to support the MEF. There were

inadequate numbers of the larger more capable USAF *Predators* to support the myriad of the ground forces requirements. The VMU, albeit limited by today's standards, provided the Marine Ground Combat Element (GCE) its only organic real-time imagery through the Pioneer remote viewing terminals located in the VMU combat operations center.¹⁶

As aircraft started to carry downlink capability on their targeting pods in 2003, ground units acquired remotely operated, video enhanced receiver (ROVER) systems that allowed direct viewing of real time imagery from tactical aircraft, USAF *Predators* and the *Pioneer*. With more capability, came more demand. As ground commanders developed an insatiable appetite for ISR, organic Marine UAS (VMU-1 and VMU-2) became the highest deployed units in the Marine Corps.¹⁷ In 2007, the Marine Corps replaced its twenty-year old Pioneer systems with the much more capable *Shadow* system and added an additional squadron, VMU-3 in 29 Palms, California.¹⁸ The capability today, as described in the Marjah vignette demonstrates the current capabilities leap from the first systems introduced in 1984. Throughout this evolutionary cycle, one area has continued to suffer, the staffing and advocacy of the officer corps. The expertise and knowledge gained by the aviators commanding the squadrons is continually lost after they leave the VMU at the end of their command tour.

-Why Doctrine Matters

It took fifty years from the winging of the first Marine aviator, Alfred A. Cunningham, for the Marine Corps to develop doctrinally the Marine Air-Ground Task Force, even though Marine CAS had been a cornerstone of how Marines fought in the Pacific during World War II.¹⁹ Once doctrinally and organizationally structured the vision and operating concepts of the air-ground team with scalable expeditionary formations allowed the Marine Corps to develop into the rapidly deployable, task-organized force of today.

Current Marine doctrine and operating concepts speak about the necessity to operate in the “*intersection of complex environments, hybrid threats... and rely as much on ‘non-kinetic’ ability of the MAGTF as they will on the violently ‘kinetic’ abilities.*”²⁰ The Marine Corps must train and prepare for large-scale conventional wars, but a majority of time and resources will be spent on conflicts in the world’s developing urban backwaters conducting ISR missions prepared to immediately conduct kinetic strikes.²¹

In Iraq and Afghanistan, Marine Unmanned Aerial Vehicle Squadrons (VMU) have shown remarkable innovation by creating effective synergies among intelligence, artillery, aviation, and ground units without the guidance of top down doctrine. The VMU not only provided commanders and operators remarkable situational awareness, it allowed unprecedented synergy and lethality, all without being armed. This increasing capability for unpiloted systems has created a dynamic where core functions of Marine aviation (aerial reconnaissance, electronic warfare, offensive air support, control of aircraft and missiles and, starting this summer with the cargo UAS, assault support) traditionally provided by manned aircraft, are increasingly being filled by ‘drones.’²² Ten years of continuous combat deployments have allowed unprecedented capabilities growth to take place without detailed doctrinal guidance from any organization within the Department of Defense (DoD). As the war in Afghanistan winds down, and more VMU squadrons stand up, the Marine Corps must establish its long-term vision in order to adequately fund, train, and equip unmanned systems.

Doctrinally, the Marine Corps still tasks its UAS platforms primarily as intelligence collection assets. The only reason the *Shadow* was able to rapidly provide support in the event described above was because of innovative aviators within the VMU and battalion. The VMU commander, with no previous UAS experience before taking command, had extensive command

and control experience in combat as an F/A-18 Weapon Systems Officer, Forward Air Controller (Airborne) and on the ground as an Air Officer. Because he saw the potential of the unmanned system, he aggressively advertised its operational capability and integrated into the ground scheme of maneuver. His previous combat deployments and his career of fires experience gave him a detailed understanding of combined arms in support of the ground scheme of maneuver and enabled him to employ the *Shadow* with current manned aviation doctrine.²³ Unmanned platforms however are more than just operational platforms that can use manned aviation doctrine. The wide divergence of capabilities, to include sourcing for CAS, ISR, EW and SIGINT missions creates division between the operational and intelligence communities within the Marine Corps.

Currently in Afghanistan there are two separate request processes for aviation platforms. UAS are requested through collection focused intelligence channels vice the Air Tasking Order (ATO) of manned fighters, bombers and helicopters. This separation of sourcing creates friction when the best asset to support an operational mission might be an armed UAS.²⁴ Our current joint doctrine from JPUB 3-09.3 supports this division by stating, *"The intelligence officer is the source of targeting data. He provides current and timely CAS targeting information, (and) serves as the focal point for ISR systems that feed real time or near real time battlefield intelligence."* As the kill chain has been decreased with the collection assets conducting their own strikes, the JTAC (or FAC), along with the UAS operator, have become both real-time intelligence collector and operational controller. This is not to say the controllers are the best equipped to analyze hours of ISR data, merely that others in addition to the trained intelligence professionals are receiving and prosecuting actionable information from the UAS feed. Complex missions, which change in a matter of seconds from area observation and analysis to target strike highlights the

need to create better fusion between the intelligence and operation communities. Without a senior organizational advocate to guide the doctrine of the unmanned community, it is unlikely that consistent operating concepts and procedures will be created across the operating forces.

-What Needs To Be Fixed

The current construct of the VMU has been overwhelmingly successful, yet extremely inefficient. Aviators chosen for command come with no formal background in unmanned systems. They arrive with expert knowledge in their own type/model/series (TMS) of aircraft, but know little to nothing about the VMU. After intense 'instruction under fire' to become a SME for the unmanned community, they depart after eighteen months, effectively providing value-added input after eight to twelve months in command. Upon departure, the former commander leaves for school or a staff tour. If the former commander is lucky enough to be selected to colonel and slated for command of a MAG, he will not be able to influence the community that he commanded as an O-5 since it belongs to a MACG. That means that the majority of the influential advocates for the community are at headquarters Marine Corps, often learning while on the job, during a three-year tour at the Pentagon.²⁵

The Marine Corps, recognizing the increased demand of the UAS, has approved a UAS officer Military Occupational Specialty (MOS) starting in 2012. The new MOS career path, although currently undefined, will provide the first commanding officer of a VMU in the year 2027, and potential O-6 or colonel in 2032.²⁶ The slow organizational infusion of UAS officer SMEs would have been adequate in 1987 when the Pioneer system initially fielded. The Marine Corps however no longer has the luxury to slowly develop tactics, techniques and procedures (TTP) while waiting for the UAS officer corps to mature against the hybrid threats. The

realization that decisions need to be made today, before UAS are armed, leaves the Marine Corps with several options to capitalize on the opportunities provided by unmanned systems.

The Force Structure Review Group's (FSRG) recommendation to expand UAS by 25% (one squadron) while the Marine Corps decreases by 7%, demonstrates the importance senior leaders place on the unmanned community.²⁷ The FSRG adds to a high volume of academic papers written about the important future of unmanned systems within the Marine Corps dating back over thirty years. Within the last two years, thoughtful and important papers have been written about the future of Marine UAS, to include CAS applicability, proposed training and readiness syllabi, and how to integrate with the Joint Strike Fighter. The addition of one squadron along with applying various ideas and concepts will not adequately provide the necessary UAS advocates within the fleet, MAWTS-1, and Headquarters, Marine Corps (HQMC) to create the right vision of the community.

The main collaboration tool to advance communities within the Marine Corps is through the Operational Advisory Group (OAG). For Marine Aviation, colonels commanding mostly community specific groups come together once a year to discuss issues and funding priorities within their specific communities. Other attendees include staff action officers from HQMC (Aviation and Combat Development Command) and MAWTS-1. At the conclusion of the OAG, the O-6 advocates agree on a resulting way ahead, delineate requirements and then take their recommendations to the general officer level for consideration.

There is no better example to understand the need for creating a new UAS organizational structure than to look at the UAS and VMU OAGs. The UAS OAG, organized by the Headquarters Marine Corps aviation (HQ AVN) UAS requirements action officer (lieutenant colonel), is comprised of an executive steering committee with "O-6 representatives from I, II,

and III MEF, MARFORRES, HQMC, and MCCDC.”²⁸ The spectrum of issues and requirements being discussed at the UAS OAG covers the range of small hand-held UAS flown by Marine ground units to the large future *Reaper* like systems. The VMU OAG on the other hand is held concurrently yet separate from the MACG Marine Air Command and Control (MACC) OAG. It is comprised of VMU squadron commanders (with an average 1 year of experience in the community), senior enlisted Marines and representatives from MAWTS-1 and HQ AVN.²⁹ This separation, with colonel commanders out of the discussion, is unthinkable for any other aviation platform or system. None of the former VMU commanders who have risen to the colonel level are directly involved in advocating for the community’s future through the VMU OAG process. The lack of adequate representation and advocacy extends beyond the OAG, into another very powerful driver within Marine aviation, MAWTS-1.

Since 1952 the Marine Corps has had specific units assigned the mission of developing the best weapons employment for its aviation assets. Today, that unit is MAWTS-1, located in Yuma, Arizona. The mission of MAWTS-1 is to, “Provide standardized advanced tactical training and certification of unit instructor qualifications that support Marine Aviation Training and Readiness (T&R).”³⁰ It does this through a twice annual Weapons and Tactics Instructor (WTI) course that trains SMEs from every aviation community within Marine Aviation.

MAWTS-1 is a driving force in developing and validating tactics and integration for Marine Aviation. The instructors at MAWTS-1 are among the best and brightest from within their respective communities. The different aviation communities are organized into departments based on their core functions. The main departments are broken down into Tactical Air (F/A-18, AV-8B, C-130 and EA-6B branches), Assault Support (AH/UH-1, MV-22, CH-46 and CH-53 branches), and Command, Control and Communication (C3 which includes UAS).

Currently, the UAS division is represented by a captain from the C3 community, an experienced gunnery sergeant and a major who specifically works integration and tactics development. As a forward thinking organization within the Marine Corps, MAWTS-1 is working to integrate UAS tactics with other aviation assets. While this is a step in the right direction, it has been largely driven by innovative officers who have worked with UAS in combat. MAWTS-1 must be given the leverage to effectively develop cutting edge tactics and operating concepts for systems that will soon be conducting five of the six functions of Marine Aviation through the creation of a stand-alone UAS Department.³¹

The first official direction given by the 35th Marine Commandant, General James F. Amos, in the fall of 2010 was through his planning guidance. He directed the Marine Corps to maintain a, “spirit of innovation and institutional flexibility.” His number two priority after supporting the war effort in Afghanistan was to “rebalance our Corps, posture it for the future and aggressively experiment with and implement new capabilities and organization.”³² The future development of combat systems in the Department of Defense won’t just be about the money, it will be *all* about the money. While the innovation and institutional flexibility within the VMU has been remarkable, budgets are rapidly being cut, and the most vulnerable programs—those that lack a dedicated senior advocate - will likely face cuts to their budget.

One of the largest advantages of unmanned systems is cost and reduced logistical burden required to operate them. A *Shadow*, using eleven gallons of fuel, can provide up to six hours on station compared to more than fifteen-hundred gallons for an hour on station from a *Harrier*.³³ Although the new systems will likely be expensive, they require about a quarter the labor and a fraction of the fuel (and compared to the cost of manned platforms, e.g. F-35, they will be extremely inexpensive).³⁴ It makes fiscal sense to expand the use and role of Marine UAS to

include the high volume of non-traditional ISR (NTISR) sorties flown today by fuel thirsty tactical aircraft. Costly jet aircraft hours, used for more dynamic missions requiring greater firepower or pilot interaction, could then be applied judiciously to missions they are best suited to support.³⁵ It must be clearly understood, however, that capable UAS will not completely replace the capabilities of advanced manned fighter/attack platforms such as the Joint Strike Fighter (F-35). Rather, UAS will allow the Marine Corps to use the JSF for missions more suited to its design and capabilities.³⁶

Many in the Marine Corps aviation community have yet to acknowledge current and potential capabilities of UAS. Some still view it mainly as an intelligence, surveillance and reconnaissance (ISR) platform with limited growth potential into traditional manned Close Air Support (CAS) roles. With the right leadership and advocacy, emerging UAS capabilities such as advanced imaging sensors, electronic attack, small precision-guided munitions, communication relay and signals intelligence can be rapidly integrated into the MAGTF single battle concept. Further, the decreased logistical footprint of the UAS due to reduced manpower requirements and low fuel consumption, coupled with long hours of loiter time, will make unmanned systems a fixture, if not a necessity, for Marine commanders.

The future weaponizing of the *Shadow* with small 81mm mortar-sized ordnance in the next twelve to eighteen months will be the first step in greatly increasing the capability of Marine UAS. As early as 2016, *Shadow*'s replacement will be capable of providing ten times the on-station time and twice the range of today's F/A-18 *Hornet* with the speed of the MV-22 *Osprey* and carrying as much ordnance as a combat loaded AV-8B *Harrier*.³⁷ This capability leap will enable the Marine Corps to conduct multiple functions of Marine aviation necessary to support the MAGTF for the conflicts of the future. (see *Appendix A* for UAS FoS Roadmap)

During World War II, an average of 108 sorties were required to destroy one target; by early OEF, the ratio had changed to one tactical jet for every four targets.³⁸ As more and more UAS become armed, it is completely conceivable that the ratio of manned tactical air sorties to targets destroyed (mostly by UAS) will be the inverse of the WWII statistic (See *Appendix C*). Weaponized UAS, capable of providing a majority of the ISR flight hours and a portion of the required CAS sorties will greatly increase the efficiency of Marine Corps aviation assets. In order to harness the rapid expansion of UAS capabilities, the Marine Corps must change its current organizational construct or face being left behind.

-What Needs To Happen

“Throughout history, even the most brilliant military minds have often failed to adapt well to new technologies. Napoleon may have conquered most of Europe, but he turned down Robert Fulton's offer to make France both submarines and steamships.”

—P.W. Singer, *Wired for War*

“If you don't know where you are going, you will wind up somewhere else.”

—Yogi Berra

Former Chief of Staff of the Army, General Eric Shinseki once admonished his own service by saying, “If you dislike change, you're going to dislike irrelevance even more.”³⁹ In order to stay relevant, the Marine Corps must again be willing to think beyond familiar methods and systems for conducting military operations, and make radical changes and adapt to the rapid growth in unmanned capability. The capabilities and value of UAS are not lost within the Marine Ground Combat Element (GCE), but the requirements and priorities for Marine aviation must come from those most familiar with the capabilities of manned and unmanned aircraft, the pilots. The aviation community seeks a balance between proven air-ground tactics and the promise of future technology, and must not let old procedures and prejudices limit the increased role and innovative application of unmanned systems taking place on the battlefield. In order to develop a competent fires-minded UAS community to support our ground forces, unmanned aircraft must

be given equal representation in the Fleet Marine Force (FMF), Marine Aviation and MAWTS-1 to compete with other manned programs.

The Marine Corps writ large, not only Marine aviation, must decide who will provide sufficient influence to properly support the vision and operating concepts of a rapidly growing UAS capability. Marine Aviation's ten-year campaign plan (2011 Aviation Plan or AVPLAN) does not adequately reflect the growing reliance that ground commanders are placing on unmanned systems. The current vision looks a lot like the past, with twenty-one active duty operational strike-fighter squadrons compared to three unmanned squadrons.⁴⁰

The increased capability of future unmanned systems will demand effective advocacy. Without strong advocates such as those currently in the assault support and tactical air communities, there is little chance that, as one Marine Colonel put it (using a wrestling analogy), anyone, "will be willing to go to the mat," and fight for critical requirements needed to fulfill a long-term vision.⁴¹ The creation of a Marine Unmanned Group (MUG) is required to provide training and safety oversight, develop doctrine and harness the potential of increasingly capable systems. The MUG will best support the development of doctrine, vision, operating concepts and requirements (i.e. funding) to best support the MAGTF in the future.

-Counter Argument: The MAG Option

The capabilities of UAS have increased significantly since 2000 when the unwanted step-children of MAG-13 and MAG-14 were moved to the MACG. The VMU, as demonstrated by the vignette in this paper, has become a vital enabler for ground and aviation platforms alike. MAG-13 in Yuma, Arizona is especially attractive because it co-located with MAWTS-1 and will be the first group to fly the F-35B *Lightning II*, Joint Strike Fighter (JSF). The JSF, already called the last manned fighter, will be capable of sending and receiving vast amounts of

information with a multitude of sensors, to include UAS. Returning the VMU to a fires-focused group will also provide the logistics framework to supply and maintain ordnance as well as change from an ISR focused asset into a capable multi-role platform. MAG-14 on the East Coast is also well suited because of its composite nature. With the only electronic attack platforms (EA-6B) in the Marine Corps, planned to be phased out by 2019, MAG-14 will be well positioned to harness the experience and knowledge of Electronic Counter-Measure Officers (ECMO) to expand the electronic warfare (EW) capabilities of unmanned systems.⁴² Another benefit of moving the VMU under the MAG will be transitioning the MAWTS-1 UAS Division from the C3 to TacAir Department. Under the TacAir Department, Marine Aviators, with a depth of experience in EW and CAS mission sets, will be able to integrate the strike capabilities of the unmanned community. (See Table 1)

Almost unanimously, every former VMU CO interviewed for this paper believes returning the VMU to the MAG is not the answer. Under the MAG they argue, the VMU will not gain a consistent advocate who will appreciate the capability of unmanned systems. The synergy from being co-located with other manned platforms is a red-herring as even in composite MAGs, such as MAG-14, over 90% of the training is internal to the type/model/series aircraft squadrons.⁴³ Manned aircraft will likely remain the number one priority, and as UAS become more capable, they will threaten the very platforms (and culture) the commanders are seeking to protect. Some analysts believe the USAF canceled its X-45 combat air vehicle testing to prevent any chance of data being given to Congress that showed it was as capable as the manned Joint Strike Fighter.⁴⁴ There are historical examples, such as the requirement by cavalry officers to demand that the first automobiles had saddles and reins, that indicate innovation and vision might be best accomplished by a whole new organization, free of pre-existing prejudices.⁴⁵

-Recommended Course of Action

As the Marine Corps debates how it should restructure for the future, there is an opportunity to create a Marine Unmanned Group (MUG) that is capable of providing the advocacy and expertise to develop the right vision for the future. Only with a vested MUG and a colonel commander, can the necessary changes take place in a relatively short period of time to ensure that armed Marine multi-role UAS squadrons are the best trained and equipped to support the MAGTF. (See Table 2)

The minimum threshold to create a MUG could be established by consolidating two of the three VMUs under one command in Twenty-Nine Palms, CA along with adding the new VMU outlined in the Force Structure Review. The necessary staffing required to stand up a MUG staff could be created from the manpower savings achieved by transitioning legacy F/A-18D, AV-8B, and EA-6B squadrons to the F-35.⁴⁶ Instead of relocating VMU-3 to the limited training location of Hawaii, as depicted in the 2011 AVPLAN, III Marine Expeditionary Force (MEF) could receive trained and ready UAS detachments from the California MUG similar to the unit deployment program (UDP) construct of other T/M/S. In order to continue to provide the necessary training for II MEF, VMU-2 would be transferred to the composite MAG-14 at its current location of Cherry Point, North Carolina in order to receive the necessary logistical support and maintenance for aviation ordnance.

Creation the first MUG out of Twenty-Nine Palms is preferred for several reasons. First, it is located in one of the best weather flying regions in the country inside of restricted airspace and will not have to deal with the current Federal Aviation Administration (FAA) rules prohibiting UAS from flying in national airspace outside of restricted areas. Second, Twenty-Nine Palms is home to the largest combined arms exercise in the Marine Corps, Enhanced

Mojave Viper (EMV), run by the Tactical Training Exercise Control Group (TTECG), that dynamically integrates all MAGTF platforms and units. Lastly, the ranges surrounding the base, along with those under connected restricted airspace in Arizona (MAWTS-1 support), will allow armed UAS to routinely train with ordnance.

In order to maintain the unmanned capability currently present on the East Coast and provide the necessary aviation expertise and ordnance support, VMU-2 will return to MAG-14 until more unmanned squadrons can create the threshold for the MUG. The MAG-14 CO, working with the MUG CO will provide a unified, standardized voice to lead the community. While it is much more difficult to fly and train on the East Coast, existing Marine airfields (such as Bogue and Atlantic Fields and bombing ranges BT-9 and 11) could continue to be used to support training with II MEF aviation and ground units.

One critical area a MUG commander must advocate is the training and development of proficient UAS Marines. Officers and enlisted must be trained with the right skills to operate these systems in order to successfully support the MAGTF of the future. Although an unmanned officer MOS will begin in 2012, there will be a considerable lag from designation as a second lieutenant to the seasoned commander able to train, equip, and lead a multirole unmanned squadron in combat. With the sundown of legacy systems and the Marine Corps losing the requirement to have naval flight officers (NFOs), the UAS community must capitalize on preexisting aviation fires skill sets today while Marines with the UAS MOS mature and prepare for command. The pool of aviation officers will be available to serve as commanders up to the expected first UAS lieutenant colonel command slate in 2027. NFOs, whose airframes will soon be retired, have invaluable experience and skills that could be harnessed to bring immediate credibility to weaponized UAS. This fires mindset must also be transferred to the most

experienced population within the UAS community, the senior enlisted. Having stayed with the squadrons while the officers have rotated in and out of the VMU, they deserve a significant amount of the credit for the capabilities growth within the community. One major deficiency that is currently not being adequately addressed, however, is a career roadmap for these enlisted Marines. A study conducted by the Center for Naval Analyses concluded that retention problems of highly trained enlisted UAS operators (MOS 7314) were linked to a lack of career-broadening opportunities. As the UAS becomes a multirole fires asset, experienced enlisted UAS operators, with the valuable understanding of aviation's three-dimensional time and space relationship, should be sent on ground tours to augment the new joint terminal attack controller (JTAC) platoons being created within the artillery regiments. After this broadening ground tour, the JTAC-qualified enlisted operators will bring an invaluable perspective back to the MUG. Necessary manpower changes to the unmanned personnel ranks, which harness the experience available today and the skills needed for tomorrow, will be best, and most likely made by a dedicated colonel advocate in the form of a MUG commander.

The MUG creation and manpower roadmap must be followed by the creation of a UAS Department at MAWTS-1, populated with experienced intelligence officers, assault support, and fires oriented aviators (eventually seasoned UAS officers) who will build a base of knowledge and be able to write sound tactical manuals and quickly advance standardized tactics, techniques and procedures (TTP).⁴⁷ This new department, which transcends all aviation communities and functions, will be best situated to coordinate and integrate with the C3, Assault Support and TacAir Departments standardizing the tactics of Marine Aviation.

Under the current USMC aviation plan, VMU squadrons will consist of widely divergent mission sets as early as 2016.⁴⁸ Although the same MOS will be working within each squadron

(using the same universal ground control stations), the missions are vastly different in scope and will demand a different organizational structure. These differences will eventually lead to the needed break-up of the VMU into an attack (VMA-U), observation (VMO-U) and possibly light lift (HML-U) squadrons. This break-up will require the creation of an additional three squadrons and one additional MUG staff. (See Table 3)

Manpower required to stand up the additional three unmanned squadrons could be gained from various areas within Marine Aviation, to include: manpower from legacy platforms transitioning to the JSF, from within existing VMU squadrons, and from consolidating planned Short Takeoff / Vertical Landing (STO/VL) F-35B squadrons from 10 to 16 jets. This will decrease the number of JSF squadrons from 16 to 13, and actually add capability by making every STO/VL F-35B capable of simultaneously supporting a Marine Expeditionary Unit (with six aircraft) and deploying to an expeditionary airfield with the remaining aircraft. The current plan calls for five F-35C, nine squadrons with ten aircraft and seven squadrons with sixteen.⁴⁹ There will also be additional manpower savings that come from transitioning out of the EA-6B, AV-8B and F/A-18D communities to create the MUG staff. Regardless of where the manpower comes from, the creation of a multi-role MUG will require a significant change to the current organization of Marine aviation. If radical changes are not made now, there is a danger that the Marine Corps will lose the capability to support the MAGTF adequately in the future.

-Conclusion:

Since the establishment of the first unmanned units in 1984, the role and organizational structure of the unmanned community has constantly changed between artillery regiments (1984-1987), SRIG (1987-1996), MAG (1996-2000) and finally, the MACG (2000-present). Capable aviators, with considerable help from enlisted UAS Marines and Control Group officers were

able to steadily increase the capability and proportional support of unmanned systems to the MAGTF. In the near future, five of the six core functions of Marine aviation will be possible from UAS. This increase in capability has not been lost by senior Marine leaders who, through the FSRG, plan to expand the size of the UAS community while most of the Marine Corps decreases.

As capability grows and the kill chain decreases, there is also a need to develop a holistic doctrine that combines the intelligence and operational utility of multi-role UAS. In absence of sound doctrine, commanders have employed Marine UAS in Iraq and Afghanistan to such an extent where the systems have become a necessity for most operations. The role of the UAS will become even more prevalent in the future through field experience, ingenuity and advances in technology. The Marine UAS, integrated as part of the Marine single-battle concept, must work to become the most capable integrated unmanned fires platform available for Marine ground commanders.

While Marine unmanned aircraft have flourished under the MACG, their subsequent arming with air to ground ordnance dictate they be relocated to a more aviation fires-employment focused organization. The capability gained from arming Marine UAS demands a radical change in organization to provide the best support to the MAGTF.

The conflicts we will likely be involved with during this century point toward illusive, unconventional, non-state enemies who blend in with a rapidly growing world population. The Marine Corps, as the nation's "911 force," must be agile enough as an organization to adapt to the threats our country faces or suffer severe cuts in our operating budget.

Only with the creation of a Marine Unmanned Group can the unmanned community reach its full potential. The eventual fielding of large armed Group 4 UAS, capable of a 1,350nm

radius and ten hours time on station, will demand a much different focus than the small tactical UAS detachments, or the cargo UAS being fielded for proof of concept in August, 2011.

Through planned manpower consolidation savings achieved in the re-structuring of the STOVL community, additional manpower may be available to split the VMU into capability specific attack, observation and cargo squadrons. In addition to the unmanned group, the creation of a UAS Department at MAWTS-1, populated with experienced intelligence officers, assault support and fires oriented aviators (eventually seasoned UAS officers) will build a base of knowledge able to write sound tactical manuals and will quickly advance standardized tactics, techniques and procedures (TTP) of the community. The outcomes will be strategically relevant --limited only by ingenuity. By training enlisted UAS operators to become Joint Terminal Attack Controllers (JTAC) and serve ground tours with the new artillery fires platoons, the unmanned community will become a balanced fires community in its own right. Unmanned systems, with persuasive leadership and an effective organizational structure, will become the most integrated combined arms, multi-role platform within the Marine Corps.

The capabilities of our unmanned systems are impressive but are only the beginning of the in the future of Marine aviation. That era however won't evolve successfully if a dedicated advocate, free of the burdens of protecting other aviation assets, isn't created. Marine Unmanned Groups, integrated at every level with our ground forces, will have the potential to redefine the boundaries of air support. MUGs will create the advocacy able to develop the doctrine, vision, operating concepts and requirements (i.e. funding) to best support the MAGTF in the future.

ENDNOTES

¹ The UAS mission commander for this operation was a F-18 Hornet Weapon Systems Officer with extensive experience as a FAC(A), TAC(A), previous Forward Air Controller (FAC).

² In the Marine Corps each infantry battalion has three winged aviators assigned as Forward Air Controllers or FACs who generally split up between the three maneuver companies. The Marine Corps is developing a JTAC program to augment the FACs as units smaller than company size are operating autonomously and need controllers for CAS missions.

³ Interview with VMU-3 CO, LtCol James "Chewy" Frey, USMC and 1/6 Air Officer, Captain Alex Ramthun, USMC, February 2011.

⁴ Interview with Lieutenant Colonel George "Myrtle" Beach, USMC, January 2011.

⁵ MAJ Jeffrey L. Cowan, U.S. Air Force, "From Air Force Fighter Pilot to Marine Corps Warfighting: Colonel John Boyd, His Theories on War, and their Unexpected Legacy," master's thesis, USMC Command and Staff College, 2000

⁶ Interviews with VMU-3 CO, LtCol James "Chewy" Frey, USMC, January 2011.

⁷ Pre-cursor to Marine Corps Combat Development Command.

⁸ Maj L R Fuchs *Marine Corps Gazette* Oct 1981; 65, 10

⁹ Interview with LtCol Beach, USMC UAS Coordinator, January 2010.

¹⁰ Maj L R Fuchs *Marine Corps Gazette* Oct 1981; 65, 10

¹¹ Mersky, Peter B.. *U.S. Marine Corps Aviation 1912 to the Present*. Annapolis, Md.: Nautical & Aviation Pub. Co. of America, 1983. Print., pg. 362.

¹² Unmanned Aerial Vehicles: Where Are They Going And Where Do They Belong, Maj Gary Warner, USMC, 1999

¹³ IBID

¹⁴ Interview with LtGen Hough, former Deputy Commandant of Aviation, November 2010.

¹⁵ IBID

¹⁶ Interviews with Colonel's Werth, Nelson, Hardison (all VMU-2 COs) and LtCol Frey (former VMU-3 CO)

¹⁷ "Video Goes To War," Proceedings November 2007. Captain R.P. Hough

¹⁸ VMU-3 Homepage, command history <http://www.3maw.usmc.mil/macg38/vmu3/history1.asp>

¹⁹ Formalizing the MAGTF in Marine Corps Order 3120.3 in December of 1962 does not mean that Marine Aviation was not used effectively to support Marines since 1912 (birth of Marine Aviation). What it does demonstrate is that doctrine often lags tactical innovation and accepted TTPs as has been shown by current UAS tactics without formal doctrine.

²⁰ Marine Corps Operating Concepts 2010, pg. 116.

²¹ Mullen, Michael G.. *The National Military Strategy Of The United States Of America, 2011 Redefining America's*

Military Leadership. Washington, D.C.: Joint Chiefs of Staff, 2011. Print.

²² Up to this point armed UAS supporting Marine Ground units have been provided by the USAF.

²³ Interviews with VMU-3 CO, LtCol James "Chewy" Frey, USMC

²⁴ One technique that has worked in the past is having an intelligence representative controlling the UAS (through MiRC chat and a live video feed) in the supported ground forces operations center. Once an operation begins, control is then passed to the JTAC with the intelligence community monitoring and ready to resume control at any time. In order for this to work smoothly, UAS need to be requested through the operational Joint Terminal Air Strike Request (JTAR) process for sourcing on the ATO.

²⁵ Interview with LtCol Huber, USMC December 2010

²⁶ DCA UAS Roadmap Decision Brief, May 2010.

²⁷ Reshaping America's Force in Readiness Report of the 2010 Marine Corps Force Structure Review Group, page 6

²⁸ UAS Operational Advisory Group Charter, 23 June 2008

²⁹ Interviews with Gunnery Sergeant Stewart Long and LtCol Frey, January 2011.

³⁰ MAWTS-1 MCO 3500.109

³¹ The five functions of aviation that UAS will conduct in the next few years include, control of aircraft and missiles, assault support, offensive air support, electronic warfare and aerial reconnaissance. The last function, anti-air warfare is not currently being developed by the Marine Corps but will likely be a capability for UAS in the future, namely against other unmanned systems.

³² 2010 Commandant's Planning Guidance

³³ Interview with VMU-2 GySgt Stewart Long, February 2011 as well as authors experience flying CAS missions with one aerial refueling to provide one hour of on-station time.

³⁴ Former Marine Commandant, General James Conway stated that the greatest logistical burden for his forces in Afghanistan was the fuel required for his forces to operate. The ACE consumes the majority of that fuel. September 2010.

³⁵ Today's fighter/bombers have relatively short on-station time (1-3 hours), are easy to visibly and audibly detect by enemy fighters and carry mostly high collateral damage weapons. Most UAS have 6-12 hours time on-station, are extremely hard to see and hear and carry low collateral damage weapons such as the AGM-114 Hellfire.

³⁷ KPP Radius 1350nm, airspeed 240kts, 10+ hours time on-station 2011 USMC AVPLAN (F/A-18 C range 2xAim-9 is 1275nm from http://www.navy.mil/navydata/fact_display.asp?cid=1100&tid=1200&ct=1) (MV-22 Osprey max speed www.navair.navy.mil/v22/?fuseaction=aircraft.main) (VMA-231 combat load 2xGBU-38 500lb JDAM, 300 rounds 25mm). Group 4 UAS is defined by USMC Family of Systems UAS Concept of Operations, (page 3) document which follows the joint classification as a UAS capable of flying any airspeed, above 18,000', weighs over 1320 lbs comparable to an MQ-9 Reaper.

³⁸ Singer, P. W.. *Wired for War: The Robotics Revolution And Conflict In The Twenty-First Century*. New York: Penguin Press, 2009. pg.140.

³⁹ IBID, pg 282.

⁴⁰ 2011 Aviation Plan

⁴¹ Interview with Colonel Werth, former VMU-2 CO, January 2011.

⁴² 2011 Aviation Plan

⁴³ Estimate of internal squadron T&R specific training obtained from multiple interviews with various T/M/S operations officers, March 2011.

⁴⁴ "Wired for War," P.W. Singer, pg. 253.

⁴⁵ IBID. 256.

⁴⁶ EA-6B T/O has 35 officers (all include maint), FA-18D T/O - 42 Officers, FA-18A/C - 24 officers, AV-8B - 26 officers, F-35B 16 PAA sqdn has 33 Officers, F-35B 10 PAA sqdn has 21 officers. 4 x EA-6B stand-down between FY17 and 20 - no transitions, 7 x AV-8B squadrons transition, 14 x FA-18C/D squadrons transition

⁴⁷ Potentially Naval Flight Officers from the sunset F/A-18D, EA-6B

⁴⁸ 2011 AVPLAN: 1. Group 4 Marine Corps Tactical UAS: Armed, 240kts, 1350nm radius, 10hrs TOS 2. Group 3 Small Tactical UAS: Unarmed, 80kts, 50nm radius, 10 hours TOS 3. Cargo UAS: tbd

⁴⁹ Speech given by Deputy Commandant of Aviation, LtGen Terry Robling to Marine Corps Association, 10 March 2011 announcing the creation of 5 carrier F-35C squadrons to support TacAir Integration aboard Navy Carriers.

ABBREVIATIONS

ACE – Aviation Combat Element
ATO- Air Tasking Order
AVPLAN – Deputy Commandant for Aviation annual Marine Aviation Plan
BDA – Battle Damage Assessment
CAS – Close Air Support
CAT II – Category of high quality targeting coordinates, specifics are classified
CMC – Commandant of the Marine Corps
COC – Combat Operations Center
CONOPS – concept of operations
DCA – Deputy Commandant for Aviation, USMC
DoD- Department of Defense
EA – Electronic Attack
EMV- Enhanced Mojave Viper
EW – electronic warfare
FAC – forward air controller
FMF – Fleet Marine Force
FSRG – Force Structure Review Group
F-35B – Joint Strike Fighter short take-off and vertical landing variant
F-35C – Joint Strike Fighter carrier variant
GCE – Ground Combat Element
GCS – Ground Control Station
GPS – Global Positioning System
HIMARS – High Mobility Artillery Rocket System
HML- Marine Light Helicopter Squadron
HQMC – headquarters Marine Corps
ISR—Intelligence, surveillance, and reconnaissance
JDAM – Joint Direct Attack Munition
JTAC- Joint Terminal Attack Controller
JPUB – Joint Publication
JSF – Joint Strike Fighter
MACC- Marine Air Command and Control
MACG- Marine Air Control Group
MAG – Marine aircraft group
MAGTF – Marine air-ground task force
MARFORRES- Marine Forces Reserve
MAWTS-1 – Marine Aviation Weapons & Tactics Squadron - One
MCCDC – Marine Corps Combat Development Command
MCTUAS—Marine Corps tactical unmanned aircraft system

MEF – Marine Expeditionary Force
MEU – Marine expeditionary unit
MOS- Military Occupational Specialty
MUG- Marine Unmanned Group
NFO – Naval Flight Officer
NTISR – Non-Traditional Intelligence, Surveillance and Reconnaissance
OAG- Operational Advisory Group
OODA – Observe, Orient, Decide and Act
PID – Positive Identification
RCT- Regimental Combat Team
SATCOM – Satellite Communication
SIGINT – Signals Intelligence
SRIG – Surveillance, Reconnaissance, Intelligence Group
STOVL – Short Take-Off And Vertical Landing
TACAIR – tactical aviation, usually referring to marine fixed-wing aviation
TACC – Tactical Air Command Center
TIC – Troops in Contact
T/M/S – Type/Model/Series Of Aircraft
(ex: type, fixed-wing fighter-attack; model, FA-18; series, FA-18C)
TLE – Target Location Error
TTECG – Tactical Training Exercise Control Group
TTP – Tactics, Techniques And Procedures
T&R- Training and Readiness (Manual)
UAS – Unmanned Aircraft System(S)
UAV – Unmanned Aerial Vehicle
UDP- Unit Deployment Plan
USAF – United States Air Force
USMC – United States Marine Corps
VMA– Marine fixed-wing Attack Squadron
VMO- Marine fixed-wing Observation Squadron
VMFA – Marine fixed-wing fighter-attack squadron
VMU – Marine fixed-wing unmanned aerial vehicle squadron

BIBLIOGRAPHY

Ash, Jack. Captain USMC. Current Air Officer, 3rd Battalion, 6th Marines. Rath-41 Flight Lead. Interview January 2011.

Beach, LtCol George B. Unmanned Aircraft Systems advocate for Headquarters Marine Corps. Interviews November – March 2010.

Conway, Gen James T. USMC Commandant speaking engagement at Marine Corps Command and Staff College, Quantico, VA. 05 September 2010.

Conway, Gen James T. "Marine Corps Vision and Strategy 2025." Headquarters United States Marine Corps, 2008.

Daigneault, Matthew. Maj USMC. Staff MAWTS-1. Interview January 2011.

Flynn, LtGen George J. "Concept of Operations for United States Marine Corps Unmanned Aircraft Systems Family of Systems." Version 2.0, 10 November 2009. Marine Corps Combat Development Command.

Foley, Ralph. Maj USMC. Staff MAWTS-1. Interview 6 February 2011.

Frey, James, LtCol USMC. Commanding Officer, former CO VMU-3. Interviews from November 2010 to March 2011

_____. "Unmanned Aircraft," Marine Corps Gazette Oct 1981; Fuchs, L. R. , Major, USMC,.

Gates, Robert M., US Secretary of Defense. "2010 Quadrennial Defense Review Report." www.defense.gov. February 2010.

Hardison, Douglas M. Col USMC. HQMC AVN ASM-1. Interviews January 2011.

Heffern, Maj Thomas V. Unmanned Aircraft Systems advocate for the Marine Corps Combat Development Command. Phone interview from Quantico, VA. 19 January 2009.

Heffern, Maj Thomas V. "Unmanned Aircraft Systems UAS Campaign Plan." PowerPoint presentation for the Marine Corps Combat Development Command. 8 October 2009.

_____. <http://hqinet001.hqmc.usmc.mil/AVN/documents/aircraft/fixedwing/JSF.htm>.

Hough, Michael A., LtGenUSMC (ret). Former Deputy Commandant for Aviation. Interviews from November 2010 - March 2011.

Huber, Mikel. LtCol USMC. Future CO VMU-2. Interview December 2010.

Krulak, Charles C. Gen USMC. "MCDP 6: Command and Control." USMC Government Printing Office, 1996.

Mullen, Michael G.. The National Military Strategy Of The United States Of America, 2011 Redefining America's Military Leadership. Washington, D.C.Joint Chiefs of Staff, 2011. Print.

_____. "Intelligence or Operations Asset?" Air, Land, Sea Bulletin, May 2011. Maj Ryan Hough

_____. "It's MUG Time" USMC Gazette, July 2011. Major Ryan Hough

Nelson, Mark, Col USMC. Former CO VMU-2. Interviews from January 2011 to March 2011

Perez, Michael. LtCol USMC. MAG-14 Operations Officer. Email interview 23 March 2011.

Ramthun, Alex. Maj USMC. Former Air Officer 1st Battalion, 6th Marines. Interview January 2011.

Trautman, LtGen George J III. "FY2011 Marine Aviation Plan." 16 September 2010.

Trautman, LtGen George J III. "Marine Aviation Employment and Integration with the Joint Force." May 2008.

Singer, Paul W. "Wired For War: The Robotics Revolution And Conflict In The Twenty-First Century." New York: Penguin Press, 2009."

Schoeman, Scott. Maj USMC. "Marine TACAIR Challenge 2020: Team the Joint Strike Fighter and the Next Unmanned Aircraft," AY 2009-2010

_____. "Small Tactical UAS," USMC Unmanned Aircraft Systems Newsletter, Vol I, issue 2 May 2010

_____. "Video Goes To War" Proceedings, November 2007. Captain Ryan Hough

Ward, Ryan. Maj USMC. Staff MAWTS-1. Email interview 25 October 2010.

Warner, Gary. Maj USMC. Unmanned Aerial Vehicles: Where Are They Going And Where Do They Belong. USMC Command and Staff College, 1995.

Werth, Mark A. Col USMC. Former CO VMU-2. Interviews December 2010- February 2011.

Williams, Joseph, LtCol USMC. CO VMA-231, Interviews January-February 2011.

Wirth, Craig, LtCol USMC. CO VMAT-203. Interview December 2010.

Wirth, Craig, LtCol USMC. UAS Officer PMOS Brief, May 2010.

TABLE 1

Option 1: Return the VMU to the MAG

Figure 1-1 (Existing MACG Structure)

<u>MACG-38, 3 MAW</u>	<u>MACG-28, 2 MAW</u>
MCB 29 PALMS, CA	MCAS Cherry Point, NC
VMU -1	VMU - 2
VMU -3	

Figure 1-2 (Potential MAG Structure)

<u>MAG-13, 3 MAW</u>	<u>MAG-14, 2 MAW</u>
MCB 29 PALMS, CA	MCAS Cherry Point, NC
VMU -1	VMU - 2
VMU -3	
VMU-5*	

*New squadron to be established per the Force Structure Review Group, date/time TBD

TABLE 2

Option2 / Step 1: Create Marine Unmanned Group-15 (MUG) In 29 Palms, California

Figure 2-1 (Initial MUG Structure)

<u>MUG-15,* III MAW, I MEF</u>	<u>MAG-14, II MAW, II MEF</u>
MCB 29 PALMS, CA	MCAS CHERRY POINT, NC
VMU -1	VMU-2
VMU -3	
VMU-5**	
HMU -X (TBD)*	

TABLE 3

Option 2, Step 2: Create 2 MUGs with Unmanned VMA, VMO and HML Squadrons

Figure 2-2 (Long Range MUG Structure)

<u>(2-2) MUG-15, 3 MAW*</u>	<u>MUG-32, 2 MAW*</u>
29 PALMS, CA	MCAS Cherry Point, NC
VMA (U) -225^	VMA (U) - 223^
VMA (U) -513^	VMO (U) - 2
VMO (U) -1	HML (U) -6*
VMO (U) -3	
HML (U)- 8*	

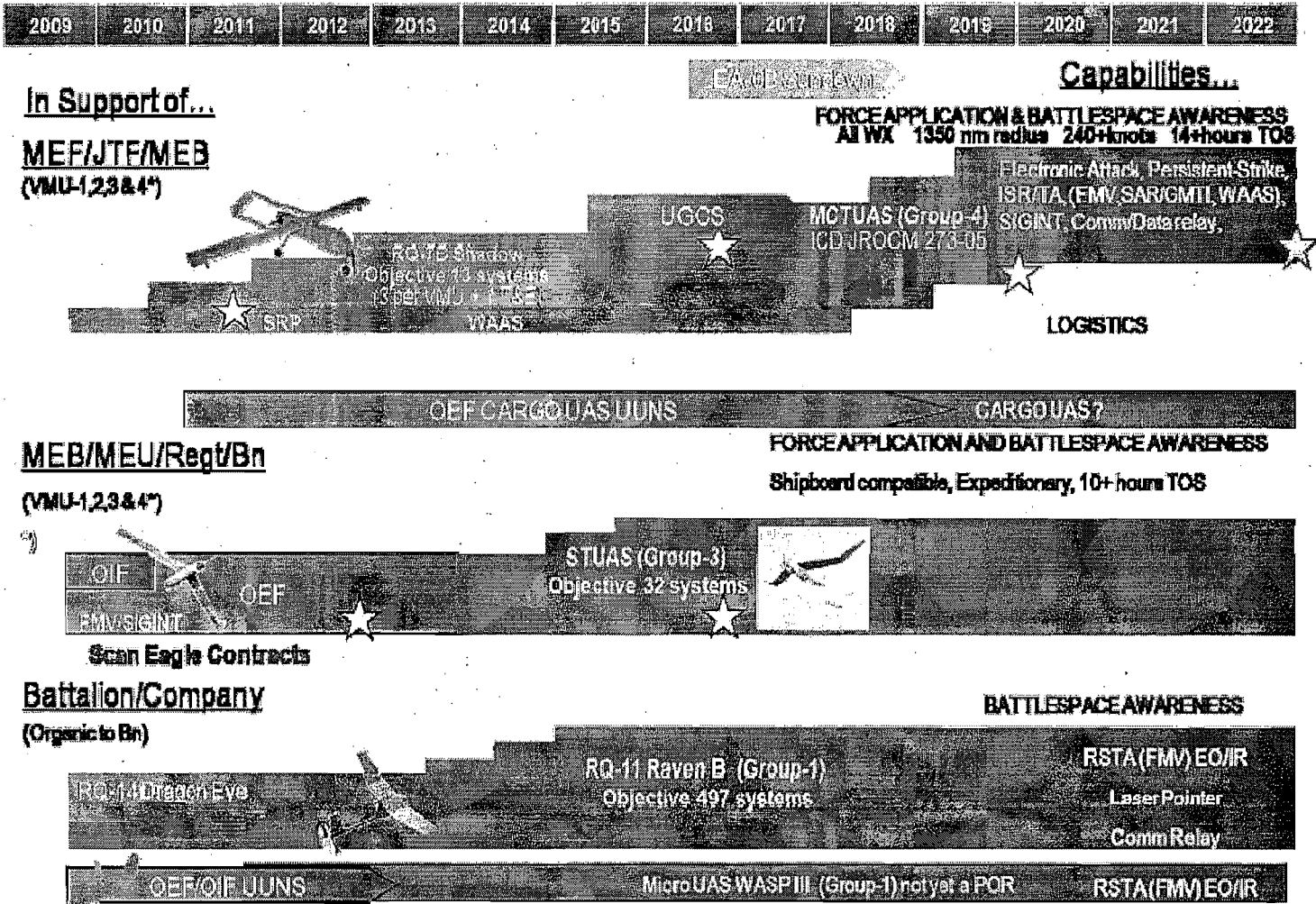
*Represent creation of command structure currently not in existence within Marine Aviation.

^Squadron numbers were taken from existing VMA and VMFA slated to transition to F-35 that would be gained by making all new F-35B squadrons consist of 16 or more aircraft.

**New squadron to be established per the Force Structure Review Group, date/time TBD

APPENDIX A

USMC UAS FoS CONOPS



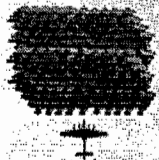
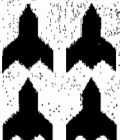
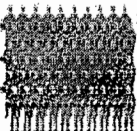
APPENDIX B

JOINT UAS CATEGORY DEFINITIONS

UAS Category	Max Gross Takeoff Weight	Normal Operating Altitude (Ft)	Airspeed	Representative UAS
Group 1	< 20 pounds	< 1200 AGL	<100 Kts	Wasp, Raven B
Group 2	21-55 pounds	< 3500 AGL	< 250 Kts	Scan Eagle
Group 3	< 1320 pounds	<18,000 MSL		RQ-7 Shadow
Group 4	> 1320 pounds		Any	RQ-9 Reaper
Group 5		Airspeed	RQ-4 Global Hawk	

APPENDIX C

USAF Evolution of Strike

	WWII	Vietnam	Gulf War	OIF/OEF	Near Future	Distant Future
Planes	 1,000 planes (B-17)	 30 planes (F-4)	 1 plane (F-117)	 1 plane (F-16)	 4 planes (MQ-X)	 Swarm (Autonomous UAS)
People	 10,000 crew	 60 crew	 1 crew	 1 crew	 1 crew	 Mission Commander
Targets	 1 Target	 1 Target	 2 Targets	 6 Targets	 32 Targets	 ??? Targets
Tech	Mass Aircraft	Tactical Strike	Laser Munitions	GPS Munitions	MAC	Collaboration
C2	In-the-Loop	In-the-Loop	In-the-Loop	In-the-Loop	On-the- Loop	Out-of-the- Loop
Mgmt	Active	Active	Active	Active	Responsive	Passive