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14. ABSTRACT
Group 1 SUAS within an infantry battalion is designed to produce a more lethal force that possesses greater organic Intelligence, Surveillance, and Reconnaissance (ISR) capabilities to achieve tactical success. This has not occurred due to the inadequate doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) derived and tested capability solutions. The lack of DOTMLPF solutions currently result in infantry battalions becoming burdened by the technology rather than enhanced. Updating these solutions to support the integration and employment of SUAS would provide a more cohesive program while making the Marine Corps infantry a more capable fighting force.

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MASTER OF MILITARY STUDIES

The Marine Corps Infantry Battalion's Newfound Dilemma:
The Integration and Employment of Small Unmanned Aircraft Systems (SUAS)

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

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Executive Summary

Title: The Marine Corps Infantry Battalion's Newfound Dilemma: The Integration and Employment of Small Unmanned Aircraft Systems (SUAS)

Author: Major Kevin C. Nicholson, USMC

Thesis: The integration and employment of Group 1 SUAS within Marine Corps infantry battalions has not produced the desired result of a more lethal fighting force due to the lack of comprehensive doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) derived and tested capability solutions. Updating the DOTMLPF solutions would provide a more cohesive SUAS program, making the Marine Corps infantry a more capable fighting force.

Discussion: The intent of Group 1 SUAS at the battalion level is to produce a more lethal force that possesses greater organic Intelligence, Surveillance, and Reconnaissance (ISR) capabilities to achieve tactical success. When reviewing the integration and employment of the Group 1 SUAS assets within infantry battalions through the lens of the DOTMLPF spectrum, each aspect falls short of the desired outcomes. The DOTMLPF analysis of a new capability, in theory, provides the solutions of the materiel and non-materiel needs of a capability to ensure the seamless and successful integration within the Operating Forces. This failed to occur with the rapid fielding of SUAS in 2004 when the infantry was given a new technology without the critical DOTMLPF solutions to ensure its success. After fifteen years of meager and varied application, the DOTMLPF solutions still have not reached a level that provides adequate support for the advanced capabilities of Group 1 SUAS.

The lack of proper support has led to infantry battalions becoming burdened rather than enhanced. From the gap in SUAS doctrinal and tactical publications to the overly restrictive and archaic training facilities, battalions are hindered when attempting to conduct realistic training. With little guidance, infantry battalions are inundated with up to five Group 1 SUAS platforms and are left to create innovative ways to utilize the systems. This has led to stagnant employment techniques grounded in current operational theater tactics, techniques, and procedures (TTPs) with widespread underutilization. Unless rectified, the Marine Corps will find itself in a near-peer conflict with a technical advantage that comes at the expense of a tactical edge.

Conclusion: Group 1 SUAS was fielded to Marine units in 2004 to meet the needs of the force and intended as a force multiplier rather than a burden to infantry battalions. The process of simply supplying an infantry battalion with SUAS assets is not adequate when the expertise on how to properly integrate and employ the systems is not resident. Revitalized DOTMLPF solutions will close the gap in manning, training, and equipping the force. This will result in an overhaul of the current usage of Group 1 SUAS and better prepare the Marine Corps for a conflict against a near-peer adversary.

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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 GOVERNMENTAL AGENCY. REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING STATEMENT.

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Preface

While conducting three combat deployments to Helmand Provence, Afghanistan, within infantry battalions from 2011 to 2017, I observed and was a part of the struggle to integrate Group 1 Small Unmanned Aircraft Systems (SUAS) into tactical operations. As the recipient of these systems with little to no education on the proper integration and employment techniques, SUAS became a burden rather than a force multiplier. My Marines and I went to great lengths to experiment with the systems in an attempt to discover the best methods of employment. Despite our efforts, adjacent commanders and I often limited the employment of SUAS because utilizing them caused undesired friction and detracted from mission focus. After experiencing this dilemma and witnessing it within other infantry units, I became convinced that there is a better way of doing business that would stop detracting from mission accomplishment and actually enhance combat lethality.

To accomplish this task, I examined the hardships of integrating and employing SUAS through the lens of the capability solutions process of doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF). I then discussed the subject with peers and conducted interviews with various Marine Subject Matter Experts (SMEs). Each SME explained how the current Operating Force is utilizing the platforms without comprehensive DOTMLPF solutions. This research coupled with my experiences explores the pros and cons of SUAS currently within the infantry battalions and identifies possible solutions and methods on how to better integrate and employ Group 1 SUAS. This paper is an effort to enhance awareness of the shortfalls of the current SUAS program and ultimately enhance the lethality of the force through greater integration and employment of SUAS while facing a near-peer adversary.

Introduction

> *Charlie Company is staged and prepared to conduct a deliberate attack on a dug-in near-peer adversary's strong point defensive position. Before commencing the assault, the commander wants to confirm the suspected locations of the dug-in machine gun positions. He orders the launch of the company level Small Unmanned Aircraft Systems (SUAS) to conduct the reconnaissance mission of the objective area. Launched from the center of the company's Operational Rally Point (ORP) three kilometers away, the SUAS operator flies the system directly toward the adversary's defensive position. Once overhead, the operator loiters the SUAS asset for 30 minutes to collect the requested information.*
>
> *In all this time, however, due to the elevation limitations of the company SUAS asset used for the mission, the system remains easily observable by the adversary. Rather than attempting to shoot down or degrade the SUAS, the adversary employs its own SUAS platforms to follow the company's system back to its point of origin (POO). The adversary can now determine the exact location of Charlie Company's ORP and can utilize this information to begin conducting fire missions on the company's static location and likely avenue of approach. This results in the complete failure of the planned attack before it has a chance to commence.*
>
> -A Fictional Scenario Based on Current SUAS Employment

Think of it! What a superb advantage: SUAS that can fly over the enemy and discern his position, his crew-served weapons, and any obstacles he has laid to kill or maim our advancing Marines. What a great potential to up the creditability and lethality of our infantry battalions. And yet, as the above scenario depicts, SUAS are not currently meeting the needs of the ground force commander and living up to their potential. SUAS are a fantastic new technology and should represent a distinct advantage on the battlefield, but with its current usage, it will likely lead to tactical blunders while engaged with a comparable adversary.

Colin Gray, a strategic studies professor at the University of Reading, warns us that "For every shiny new solution, new problems will be discovered. The principal reason why this is always so is because of the inconvenience represented by the enemy."[1] This uncertain future operating environment demands the Marine Corps to review every aspect of how SUAS is currently distributed and utilized as the adversary of the future will have a vote. As of now, the integration and employment of Group 1 SUAS within Marine Corps infantry battalions has not produced the desired results of a more lethal fighting force due to the lack of comprehensive

doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) derived and tested capability solutions. Updating the DOTMLPF solutions would provide a more cohesive SUAS program, making the Marine Corps infantry a more capable fighting force.

The current lack of DOTMLPF solutions creates a large void in the necessary knowledge and expertise of proper integration and employment of the SUAS platforms across Marine Corps infantry units. This has led to the underutilization and misuse of the systems across not just the infantry where the majority of the Group 1 systems reside, but within the force at large. The introduction of SUAS to the infantry is an attempt to achieve a higher percentage of battlefield awareness and to provide small units organic Intelligence, Surveillance, and Reconnaissance (ISR) capabilities. Although the systems continue to become more capable, the stagnant DOTMLPF solutions fail to provide the necessary conditions. Without these supporting conditions that enable seamless integration and employment, the ultimate goal to enhance a units combat capabilities falls short.

With the current focus of employment taking place in a relatively passive and asymmetrical environment that allows for predominantly defensive operations or limited offensive operations from a defensive position, the Marine Corps has become overly confident. These operations are conducted mainly from Forward Operating Bases (FOBs) such as patrol bases or outposts against an irregular enemy force. Although FOBs are tactically achievable in the current and recently past low-intensity conflicts, they are a non-existent option for front line troops while pitted against a near-peer adversary on the battlefields of the future.

This paper will first define SUAS in terms of “Group 1” assets and their intended mission set while reviewing the current SUAS assets utilized within the Marine Corps. Second, this paper

will explore all aspects of the DOTMLPF capability solutions from the United States Marine Corps as a whole and the overall integration and employment of SUAS within infantry battalions in particular. Throughout this paper, possible solutions across the DOTMLPF spectrum will be identified in an attempt to offer possible solutions to the current issues plaguing the integration and employment of SUAS. This is in an effort to stimulate discussion on the current SUAS program and ideally lead to the Marine Corps infantry being a more lethal fighting force that is enabled rather than burdened by the added technology on the battlefield.

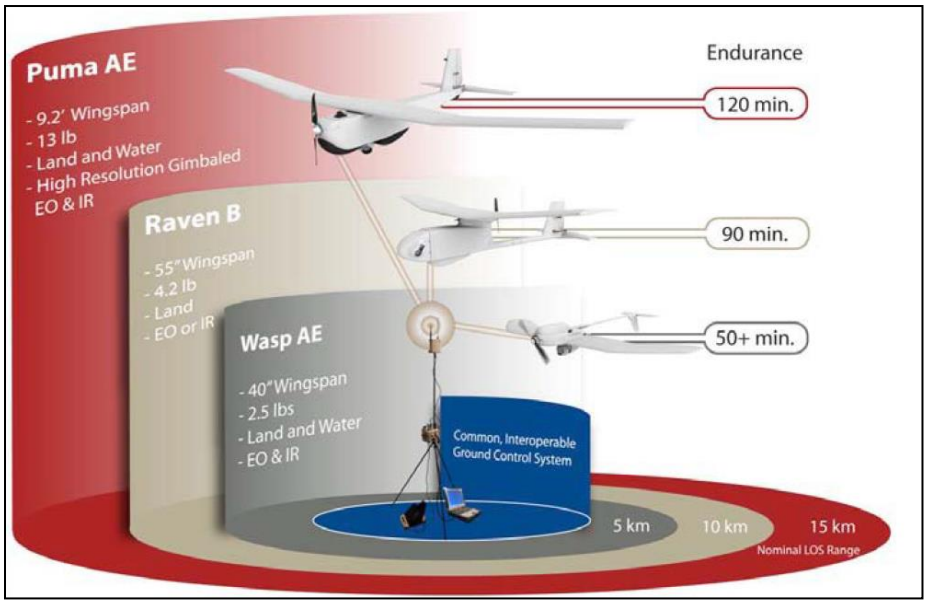
Group 1 SUAS Defined

"Group 1-SUAS" consists of man-portable platforms that provide small units an organic means to conduct intelligence, surveillance, and reconnaissance (ISR) operations.[2] The systems weigh less than 20 pounds and travel at speeds no greater than 100 knots per hour while operating below an altitude of 1200 feet above ground level (AGL). (Table 1)[3] Group 1 systems have manual operator controls where the ground station operator can manually fly every aspect of a mission, or the systems be preprogrammed to fly specified routes to accomplish preplanned missions.[4] These systems collect live video and imagery through onboard cameras which are directly streamed to the operator on the handheld controller at the launch site.[5]

UA Category	Maximum Gross Takeoff Weight (lbs)	Normal Operating Altitude (ft)	Speed (KIAS)	Representative UAS
Group 1	0-20	< 1200 AGL	100 kts	WASP III, TACMAV RQ-14A/B, Buster, Nighthawk, RQ-11B, FPASS, RQ16A, Pointer, Aqua/Terra Puma
Group 2	21-55	< 3500 AGL	< 250	ScanEagle, Silver Fox, Aerosonde
Group 3	< 1320	< 18,000 MSL	< 250	RQ-7B Shadow, RQ-15 Neptune, XPV-1 Tern, XPV-2 Mako
Group 4	> 1320		Any Airspeed	MQ-5B Hunter, MQ-8B Fire Scout, MQ-1C Gray Eagle, MQ-1A/B/C Predator
Group 5	> 1320	> 18,000 MSL	Any Airspeed	MQ-9 Reaper, RQ-4 Global Hawk, RQ-4N Triton

(Table 1)
Unmanned Aircraft Systems Categorization Chart

The Marine Corps' Group 1 portfolio currently consists of three systems which include, by their designations, RQ-11 Raven, RQ 12A Wasp, and RQ-20 Puma.[6] These are all fixed-wing assets, and together they form the Small Unit Remote Scouting System (SURSS) program of record. (Figure 1) [7] Each of these systems is resident within Marine infantry battalions and distributed at the discretion of the commander to best support each company. There is nothing within current doctrine regarding the specified or directed distribution of the SURSSs within a given unit. This lack of direction requires each infantry battalion to develop its own unique solution to the problem on how to integrate the systems to best accomplish its assigned tasks.[8]

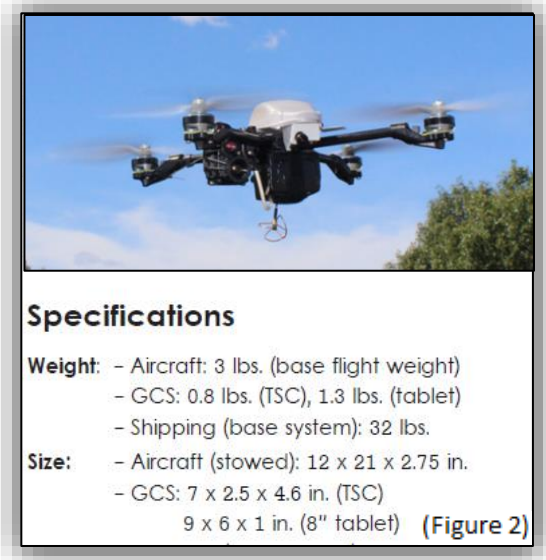


(Figure 1)

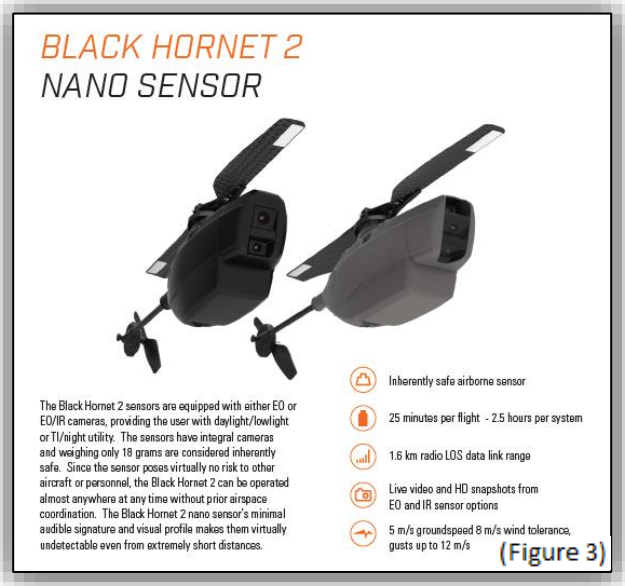
Small Unit Remote Scouting System (SURSS)

The InstantEye (Figure 2)[9] and PD-100 Black Hornet (Figure 3)[10] are non-program of record systems within the Marine Corps portfolio which are the only vertical take-off and lift (VTOL) systems currently resident at the infantry battalion.[11] This is with the exception of units that are experimenting with 3D printed VTOL systems.[12] These VTOL systems are maintained and operated at the squad level and allow for rapid use due to the limited support needs

compared to the fixed-wing systems. The fixed-wing assets require Radio Frequencies (RF) and more robust ground command stations which allow for greater flight distances. Each of these VTOL SUAS generally supports squad and platoon-sized operations with operators being resident within each squad.



InstantEye

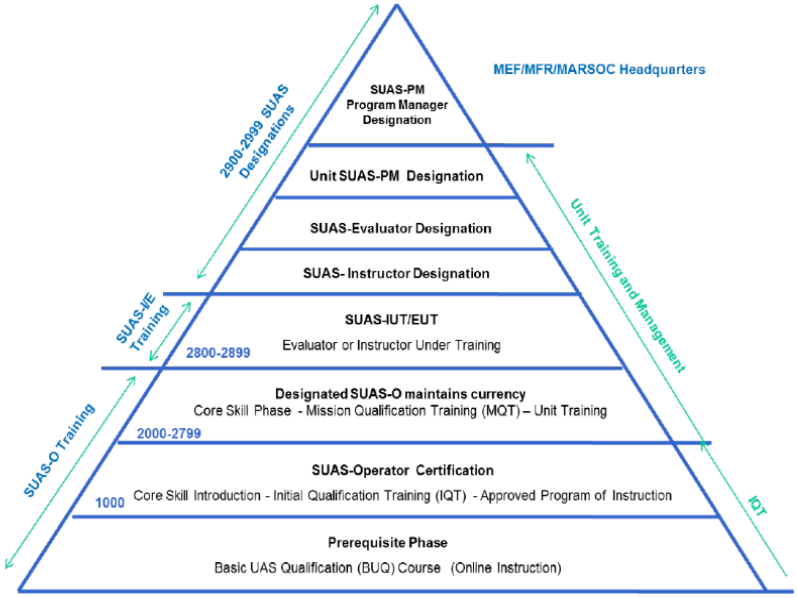


PD-100 Black Hornet

Marine Corps SUAS Doctrine

The Marine Corps has a specific and detailed doctrinal manual on how to implement and integrate SUAS within infantry battalions but lacks doctrine on how to properly employ SUAS within tactical operations. The implementation guidance resides within the "Group 1 Unmanned Aircraft Training and Readiness (T&R) Manual" dated 26 March 2014.[13] This publication covers information from the proper Table of Equipment for an infantry battalion to the specific standards a Marine must meet to become a SUAS operator.[14] This T&R manual includes the training progression model (Figure 4) and outlines the required skills that SUAS operators must master during training to achieve higher qualifications.[15] Since all training past the introductory training is conducted at the battalion level by the command designated SUAS manager, the

information within the T&R manual assists commanders in ensuring their unit possesses a mission ready SUAS program with capable SUAS operators.



(Figure 4) - SUAS Training Progression Model

For entry-level training for SUAS operators, the Marine Corps has established two schoolhouses, Training and Logistics Support Activities East and West (TALSA-E / TALSA-W).[16] These schoolhouses are responsible for the training of all new SUAS operators while also supporting all logistical needs for sustaining the SUAS platforms in the operational forces. Each TALSA runs continuous 10-day "Initial Qualification Training (IQT)" 1000 level courses that qualify selected Marines on each specific platform.[17] This is the only formal instruction that newly minted SUAS operators receive before returning to their units where they will, in theory, conduct 2000 level and above training from their unit's in house instructor, generally the assistant intelligence officer of the battalion.[18]

When the Marine graduates the 10-day IQT course, they possess the skills necessary to establish a ground station, launch, fly, and recover the assets.[19] These are all extremely

important, but what the schoolhouses do not teach sufficiently is the integration within the maneuver unit's tactical operations. This ultimately leads to the lack of expertise needed to fully integrate within the unit and develop the necessary trust and confidence within the unit's members on the system's and operator's capabilities.[20] Trust and confidence is currently built through trial and error due to the absence of manual or handbook to reference on tactical guidance or employment.[21] This results in small unit leaders, commanders, and SUAS operators utilizing each system below its full potential.

The development of a warfighting or reference publication that outlines the best practices and basic principles of integrating and employing SUAS would establish a baseline of trust and confidence in the tactical application of SUAS. The current T&R manual does not suffice as the only SAUS doctrinal publication as it only outlines procedural flight applications.[22] A tactical handbook would be beneficial to both the SUAS operators and the small infantry unit leaders and commanders. This handbook coupled with a Marine's early exposure to SUAS within their various training pipelines would be extremely valuable and create a buy-in of the assets. Squad leaders to battalion commanders are currently reliant on the information a SUAS operator learns at a 10-day course for all technical information of SUAS within the battalion; this is neither sufficient nor practical.[23]

With SUAS now being an interwoven and potentially an integral aspect of infantry operations, greater education of the small unit leaders and commanders that are charged with managing, integrating, and tactically employing the systems is necessary. Greater exposure to the systems could come as early as entry-level training, such as the School of Infantry (SOI) or at The Basic School (TBS). If too early, their exposure to the systems could come later as infantry Marines are in school for their MOS billets, such as Infantry Small Unit Leaders Course for

squad leaders and the Infantry Officer's Course for platoon commanders. Having the discussions and practical applications on the integration and employment of SUAS during this time is crucial to prepare junior infantry leaders to utilize SUAS within tactical operations.[24] This exposure will be an educational starting point to ending the era of misuse and underutilization of the tactically valuable assets.

Current SUAS Organization

Marine Corps infantry battalions are allocated a specific number of assets that allow for the completion of assigned missions while integrating SUAS. According to the current T&R manual, each battalion maintains (3) Pumas, (3) Ravens, (2) Wasps, and up to (54) InstantEyes.[25] The Nano is not resident in all battalions and remains in an experimental status and selectively fielded.[26] This current allocation of assets allows battalions to retain two fixed-wing assets for its collection plan and for each rifle company to have two fixed-wing assets as each squad maintains two VTOL assets.

The Puma system is the largest and most capable platform that resides at the regimental and battalion levels.[27] This platform is generally in support of the main effort of the battalion and the battalion's collection plan. When the asset is in support of a company, the company generally receives the Puma system and is charged with operating it with its organic operators.[28] This ultimately allows for the battalion to maintain its operators to continue the battalions collection plans.[29] Distributing systems this way taxes the limited company level operators and detracts from the inherent SUAS capabilities while taking additional infantry Marines off the line and transplanting them into a supporting role. When the Puma is accompanied by an operator, the individual comes from the S-2, and it takes time for them to integrate with a rifle company.[30] The

limited number of S-2 SUAS operators leads to a lack of flexibility when required to shuffle them around the unit to where SUAS support is needed.[31]

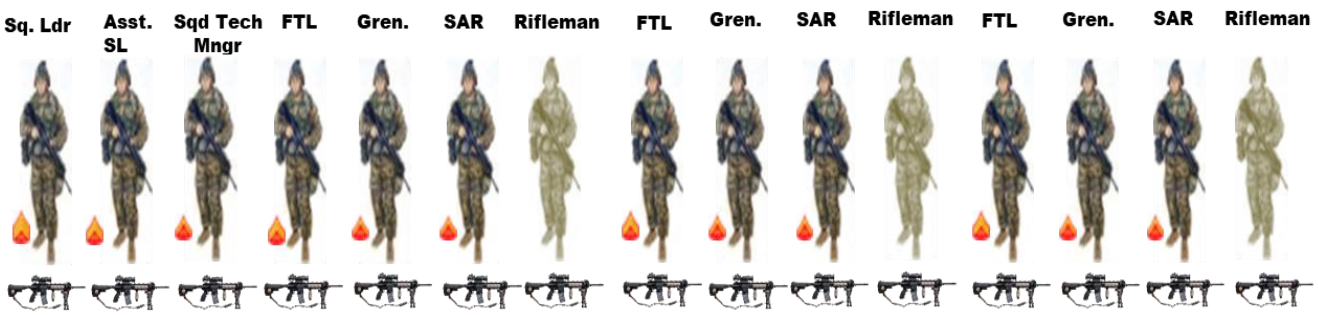
Utilized as the primary platforms at the company level are the Wasp and Raven which are fairly interchangeable in employment functionality, but require separate 10-day TALSA led training courses.[32] These platforms support company and platoon level operations with the organic operators from either the company headquarters platoon or the rifle platoons. The Company's attached (0231) analyst is the Company Level Intelligence Cell (CLIC) leader and is often in charge of maintaining the Company's SUAS.[33] This individual is the default SUAS manager of the company and ensures the selected infantry operators have a basic understanding of how to launch and recover the assets.[34] This current configuration demands the analyst must be an expert with SUAS and have the personality to instruct junior infantry SUAS operators while advising superior squad leaders and commanders of the company.[35] This is often not the case due to the lack of familiarity with the infantry, lack of SUAS instructor training, and demanding CLIC responsibilities.[36]

The last officially distributed platform is the InstantEye as the Nano is not allocated to all infantry battalions currently.[37] The InstantEye is a VTOL quadcopter that each infantry squad possesses and utilizes for platoon and squad level operations.[38] Infantry Marines from within the squad operate this system which is designed to build the enhanced local situational awareness of the squad and to "see beyond the next terrain feature" during all operations.[39] The fielding of the InstantEye to the squad level is still an ongoing process and will give the squad its own organic ISR platform which is new ground for the Marine Corps. The command-and-control with proper de-confliction will be demanding at the company and platoon level for the InstantEye as well for the Nano micro platform.[40]

SUAS Integration

The SUAS operator training begins by selecting individuals who are capable of performing the required tasks and that are occupying a billet that is able to support the desired unit. The only requirement to attend the TALSA training course is the completion of the online Basic UAS Qualification course (BUQ) as seen in (Figure 4).[41] This leads to infantrymen comprising the vast majority of SUAS operators supporting infantry battalions, specifically riflemen (0311s). This is due to a large number of young riflemen inherently within an infantry battalion that are easily applied to the requirement. This tax on the battalion's riflemen currently takes away from the squad's combat power as it loses members of its team to operate the numerous SUAS platforms within the company. The idea is that the impact of losing a riflemen is outweighed by the addition of greater situational awareness and intelligence provided by the SUAS, but this often falls short due to lack of employment and integration into operations.

Within the proposed Marine Corps Force 2025 modified rifle squad Table of Organization (T/O) developed by the Plans, Policies & Operations Infantry Advocate (POG) dated 24 October 2018, a Marine from the squad will be billeted as the "Squad Tech Manager." (Figure 5)[42] This would officially take the infantry duties away from this infantryman and relegate the individual to being solely responsible for the technological assets of the squad. The modification to the squad T/O would strip riflemen from their primary MOS and have them conduct non-MOS driven tasks. This proposed 2025 T/O is less than ideal for these reasons and needs reevaluation with a focus on the manpower model of sustainment and riflemen progression. Each squad having a resident "tech guy" would undoubtedly be beneficial on the future battlefield, but the loss of an additional riflemen is a hefty price.



MCF 2025 Rifle Squad (Figure 5)

Other than the SUAS Program Manager, usually the S-2A, the SUAS training within a unit begins and ends with the designated operators at TALSA.[43] The small unit leaders from squad leaders to company commanders have little buy-in on the integration and employment of the SUAS due to the forced integration without any formal education. The full potential is not realized which leads to further misuse and underutilization of the systems. This is when a small unit leader's sheer thought of integrating a SUAS asset into an operation becomes a burden rather than a tactical enhancement as intended.

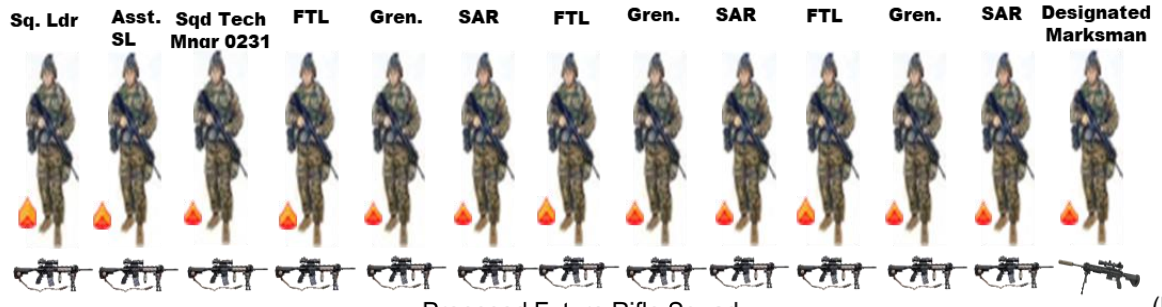
To ultimately produce a more lethal force, the establishment of formal courses for small unit leaders and commanders will create buy-in within the program. As Captain Welsh and Captain Webb, the Intelligence and Air Officer for Third Battalion, Third Marines respectfully stated in their *Marine Corps Gazette* article, "Our investment in the SUAS continues to be focused on technology in volume, not tactics."[44] The abundance of SUAS without the proper education and expertise on employment leads to slow discovery learning and lack of successful employment.

The current necessity to have an infantryman fill the billet of the SUAS operator leads to a lack of employment due to a multitude of reasons. A possible solution to this problem is to stop requiring infantrymen to become SUAS operators entirely. With the current and future involvement of SUAS only becoming a more significant aspect of operations, it is time to create a SUAS operator Military Occupation Specialty (MOS). A MOS designated SUAS operator

would require the training and expertise on SUAS integration and employment to ensure they are intelligently advising squad leaders and commanders within the rifle company. The addition of this quality MOS designated SUAS operator would change the dynamic of SUAS within the rifle companies and ensure greater employment across the operating forces.

The SUAS MOS would be best suited as a secondary MOS within the intelligence community where SUAS is currently nested tightly. Entry level intelligence analyst (0231s) would be the target population that could receive the SUAS operator MOS and able to support down to the squad level. With (648) rifle squads in the Marine Corps, this would be the starting number of required SUAS operators that would join the squads permanently. Currently, these individuals would attach to the (13) man squads and function as an enabler, not so different than how a Dog Handler or a Combat Engineer does now. Losing an infantryman billet to a MOS designated SUAS operator would now have added benefit of increased situational awareness and intelligence gathering which would increase the lethality of the squad.

With the proposed 2025 (15) man infantry squad (3 gapped billets), this SUAS operator would take the place of the "Squad Tech Manager."[45] This would alleviate the necessity of an infantryman filling this billet and allow for a more capable and greater trained individual to provide enhanced capabilities to the squad. The infantryman gained back to the squad could be billeted as the official "Designated Marksman" of the squad while again establishing a (13) man unit (12 infantrymen) with no gapped billets. (Figure 6)



Proposed Future Rifle Squad (Figure 6)

The addition of the SUAS operator MOS and the training for small unit leaders on how to properly integrate and employ SUAS during training exercises and operations will enable SUAS to become a force multiplier rather than the burden it currently becomes. No longer would an infantryman be selected to leave the squad, only to come back ill-prepared as a SUAS operator. Now a highly trained, MOS designated Marine, joins the squad to advise the squad leader on integrating SUAS and properly employs assets in support of squad and platoon operations. This individual will also replace the current CLIC Marines within the squads which will enhance the squad's organic intelligence functions. This coupled with the education of the small unit leaders on the integration and employment of SUAS will give the units the trust and necessary confidence in SUAS capabilities. This will ultimately lead to greater utilization of the systems which will make the infantry a more lethal fighting force as desired.

With infantry units set up for success with efficient manning and education on SUAS, the current outdated training installations and facilities that infantry units are bound to need updating to allow for units to fully utilize their new enhancement.[46] When SUAS became a regular part of training, units immediately ran into roadblocks that prevented them from truly integrating Group 1 SUAS. These issues, although now being worked through, persist on predominate training installations which detract from small unit training.[47] The bulk of installation impediments include the lack of frequencies available for fixed-wing use, the need to have pre-planned launch and recovery sites during non-live fire events, and the lack of de-confliction training that units and installations currently possess.

When East Coast infantry battalions conduct deployment for training (DFT) events, a common location is Fort Pickett, Virginia. Fort Pickett is great for maneuver training with premier live fire range complexes but lacks the infrastructure to support realistic integrated

training with SUAS platforms. This specific installation has three established frequencies dedicated to the use of SUAS which means only three platforms from a training unit or multiple units can conduct flight operations simultaneously.[48] This leads to units struggling to obtain frequencies when desired, and forces units to over plan the use of SUAS within operations which detracts from the realistic usage of the systems. The lack of frequencies available to units for the conduct of flight operations forces the range operation sections of installations to obtain detailed flight plans from unit's days if not weeks before execution to ensure adequate frequency de-confliction.[49]

The range operations section requires a detailed concept of operations that outline the exact launch and recovery sites with specific flight plans of all utilized platforms.[50] This is to ensure de-confliction with the FAA and other training units which cannot be completed by Joint Terminal Air Controllers or Forward Air Controllers during training.[51] Although it is necessary to de-conflict all air assets, this method prevents training units from fully embracing and employing the assets as intended. Ultimately, this task becomes impossible to complete with a unit attempting to employ multiple companies in a free play non-live fire scenario over a week-long period while utilizing dozens of SUAS platforms. This leads to the canned usage of SUAS on live-fire ranges and from pre-planned landing zones which is not within the scope of how SUAS is utilized when facing a near-peer adversary.[52]

This is not unique to Fort Pickett, as the training installations across the Marine Corps and Army need to modernize.[53] They need to modernize for the current aspect of how SUAS is attempting to be employed and also to the point of embracing nearing future employment concepts such as "swarming." Zachary Kallenborn and Philipp C. Bleek define swarming as "multiple unmanned platforms and/or weapons deployed to accomplish a shared objective, with

the platforms and/or weapons autonomously altering their behavior based on communication with one another."[54] Current training installations need to change standing limitations that inhibit methods of employing SUAS within current maneuver formations to continually experiment and improve SUAS capabilities.[55]

Establishing restricted operating zones (ROZs) and "keypads" as pre-coordinated control measures between training units and range operations is a current method that training installations have recently adopted.[56] This is in an effort to achieve less restrictive SUAS flight. Range control conducts de-confliction with the FAA to establish the ROZ or "keypad" at the request of the training unit. This is permitted through the FAA issued "Class G Certificate of Waiver or Authorization" which specifically allows the military complete airspace control over the specified installation for the use of flying SUAS.[57] This Class G waiver allows for the training unit to call in the ROZ "hot" after the required coordination.[58] The employment of SUAS on training installations has dramatically improved, but additional unrestrictive measures can be developed.[59]

As SUAS proliferates within the infantry, training installations need to view the utilization of SUAS as the norm and not an anomaly. The request to employ SUAS will be as common if not more so then the request to go "hot" to shoot a ground-fired weapon system. If conducting SUAS flight operations were viewed as employing current weapon systems such as artillery or direct fire weapons, there would be little change to current operating procedures. This would require the deviation from the more complicated ROZ de-confliction model and rely on the more simplified surface danger zone (SDZ) method used for weapon systems. The establishment of the SDZ de-conflicts all manned aircraft while allowing the training unit the

freedom to fly within the capacity of the system rather than have a restricted zone that limits creativity and realistic training.

SUAS Employment

The internal de-confliction of all air within an infantry battalion's training area is coordinated by the battalion Air Officer or the Forward Air Controller through range control and supporting aircraft. This responsibility includes coordination with the SUAS operators and each of their planned flights, to the sorties of manned aircraft in support of the battalion's scheme of maneuver. With the number of flights the limited air personnel of an infantry battalion has to coordinate, the education and experience of the SUAS operators must be high to alleviate any unnecessary or redundant coordination. Unfortunately, this is not the case due to the individuals that are selected to be SUAS operators are junior infantry Marines that are new to their units. These individuals have a difficult time attempting to complete both their infantry tasks as well as their SUAS operator commitment. After receiving a 10-day initial operator's course, the SUAS operators are not prepared to coordinate any of the de-confliction of their own SUAS flights, as it is not an introductory skill taught within the course.[60]

Due to the inability of SUAS operators to de-conflict and coordinate the flights that their leadership is requesting them to conduct, the small unit leadership now takes on the burden of conducting the coordination for the flight with the battalion Air Officer.[61] This is not ideal as the SUAS operator should be educated and equipped to call in and coordinate at the appropriate level to successfully perform a SUAS flight in support of their unit. For example, if a squad leader wants to utilize the InstantEye quadcopter to conduct a route reconnaissance mission, the squad leader should be able to turn to his SUAS operator and task them to conduct the flight. The SUAS operator should then be able to quickly plan the route, the launch and recovery sites, and

call in the appropriate mission details to conduct coordination with the company leadership. This is hardly the case as the average SUAS operator does not understand the coordination necessary to complete a flight.[62] This requires the squad leader to shift focus from the mission at hand and become consumed by the preparation, conduct, and aftermath of the SUAS flight by exercising direct command-and-control of the supporting operation.

At the battalion level, command-and-control of SUAS flights is difficult to manage. This is due to the potential number of flights being conducted at one time, the lack of de-confliction experience of the SUAS operator, and because the coordination rests in the hands of two individuals, the battalion Air Officer and Forward Air Controller (FAC).[63] In theory, at any given time, over (30) SUAS assets within just one infantry battalion can be conducting either launch, flight, or recovery operations within the battalion's area of operations. This alone is too much for two individuals to handle and can lead to the delayed approval of flights and detract from the overall efficiency of the integration of SUAS. The sheer number of SUAS flights that may be conducted at a given time over-saturates the Air Officer's and FAC's time and detracts from their original purpose of coordinating manned fixed and rotary-wing air support for the battalion's operations.[64]

Possible solutions to this problem include a more decentralized approach to controlling the SUAS. The establishment of doctrinal procedures that span across the Marine Corps rather than forcing every infantry battalion to conduct discovery learning on how to best control the air would set the foundation. This, coupled with a greater level of training for the SUAS operator would allow them to be an active participant within the de-confliction process rather than a passive recipient that has all initiative stripped away.

Possible procedures could be to establish semi-permanent or standard de-conflictions measures through time and space. Time would be much more restrictive and possibly hindering to a maneuvering unit if it is unwarranted or unnecessarily levied time restrictions. Space de-confliction conversely is more simplified as it would allow SUAS to remain below certain altitudes and within a ROZ that a manned aircraft would remain above or adjacent. Just as the SDZ for a ground-fired weapon system fouls airspace, the appropriate ROZ or SDZ establishes a restricted fly zone that elevates the unnecessary friction during de-confliction.[65] Currently, a squad does not request approval for every rocket shot it takes, so they should not have to request every time they desire to utilize its organic SUAS. This would develop a standard de-confliction aspect to controlling multiple assets while the battalion Air Officer can conduct further de-confliction as necessary.[66]

This standing de-confliction would alleviate and decentralize a tremendous amount of additional command-and-control exercised by the battalion's Air Officer.[67] Now allowing company commanders to initiate local SUAS operations within their AO without having to call for permission which gives the initiative back to the maneuver units. Company commanders with a firmer grasp on operations within their AO would be able to delegate authority down to their platoon commanders when necessary to accomplish more timely SUAS missions in support of tactical operations. The more fluid approval process to utilize SUAS would return valuable time to the commander and allow for advanced employment techniques to be explored and mastered down to the squad level.

An advanced technique in which to utilize SUAS at the tactical level is to call for and observe supporting fires from indirect-fire weapon systems. This method was explored in detail eight years ago by Major James Kay within his Master of Military Studies thesis.[68] Major Kay

focused on how SUAS integrated with the Fire Support Team (FST) within a rifle company or artillery battery is able to conduct target accusation.[69] He states that "this method does not present itself very often in offensive operations where the battlefield is dynamic and fluid. It does work well in defensive operations."[70] Even with substantial technological advances with Group 1 SUAS since 2011, target accusation and execution remains challenging for tactical units to conduct efficiently within offensive operations due to the high-tempo and ever-changing enemy situation.

Infantry battalions currently utilize SUAS most effectively within a defensive role, rather than integrating them within offensive actions due to the nature of recent conflict. Through the last fifteen years in which the Marine Corps has been engaged in conflict while utilizing SUAS, the majority of flights originate from operating bases that are permanent or semi-permanent locations. These locations are ideal for the launch and recovery of SUAS due to their relative protection and static nature. The standard mission that SUAS conducts from these static locations is ISR which enables the small unit leaders to build their overall situational awareness.[71]

This situational awareness becomes vitally important while operating out of a static position such as a FOB due to the inherent loss of tempo, momentum, and speed relative to the adversary. The adversary has the freedom of movement around the static locations and the only viable way for the Marine Corps to interdict this freedom of movement is through systems that provide ISR. The use of a G-boss, a Raid Tower, or an Aerostat provides a tremendous capability while viewing immediate surrounding terrain in a direct line of sight, but lack the ability to observe past direct fire range and in the surrounding dead space. Although a very useful tool, the use of SUAS takes ISR to the next level to enhance the overall situational awareness of the static unit.

SUAS accomplishes this task by providing observation within surrounding dead space and outside of direct fire range. This allows the unit to deny the adversary the freedom of movement in the surrounding areas when not actively patrolling. The development of Named Areas of Interest (NAIs) allows for units to focus their SUAS assets on geographic locations where activity is happening that will provide actionable information to the unit. In current operational theaters, this is generally historical Improvised Explosive Device (IED) locations, Indirect Fire (IDF) POOs, and future friendly patrol routes. SUAS assets allow a unit to observe these locations at high activity times to either deter adversary actions or to observe and target these activities.

The use of SUAS within this capacity is critical while in these static locations and greatly enhances the unit's survivability while providing greater capacity and depth of lethality from a defensive location. The systems greatly improve a unit's force protection and deny the adversary the absolute freedom of movement once enjoyed which allows the small units to gain an advantage when conducting patrols. Although this is a critical capability, the use of SUAS in this way will not be achievable when facing a near-peer threat with similar SUAS assets and SUAS denial capabilities. The utilization of operational bases by front line troops will no longer be applicable in a near-peer conflict which is why the need to master the offensive use of the SUAS assets is a necessity.

Due to the use operational bases being an obsolete TTP when facing a near-peer, small units must integrate SUAS into every training exercise, especially offensive operations and maneuvers. Many units have begun the exploration of integrating SUAS into offensive operations simulated against a near-peer, but these training evolutions are providing little to no valuable feedback. This is due to a false sense of confidence gained through using SUAS with

the same TTPs used while conducting defensive operations. As outlined in the introduction page, the use of Group 1 SUAS from a static location within range of an adversary's position will only degrade the lethality of a unit and compromise the unit's security.

This degradation imposed by the adversary will come in many aspects that will result in the ultimate failure of a planned offensive operation. If the adversary utilizes its SUAS as the Marine Corps currently does against adversaries in Iraq and Afghanistan, the results will be similar to the introduction scenario. This is due to the immediate knowledge a static unit can obtain when observing an adversaries SUAS platform conducting an ISR mission over or even offset of its location. With the little deviation of SUAS platforms and open source information on all program of record assets, it is well assumed that any possible adversary knows the capabilities and limitations of asset employed within its area of operations. This knowledge alone will hamper the usefulness of these assets on the future battlefield.

When a Marine Corps program of record SUAS asset is observed conducting an ISR mission over, or offset of an adversary position, there are a few things the adversary can immediately determine. First, is the maximum range that the system is operating from due to each system having a specific max range that it can travel away from the ground control station.[72] Second, is the approximate loiter time that the system will have on station over the adversary position due to the known battery endurance that each system maintains.[73] Third, is that the direction from which the system approached is the most likely direction of the static attacking force. Fourth, is the fact the operator is in a static position and most certainly with the leader of the attacking force due to the leader observing the video at the ground command station. This immediately gained information allows for the adversary to choose which SUAS platform they will employ to conduct counter ISR on the Marine SUAS.

Just as the Marine Corps currently conducts counter ISR on adversary SUAS assets, the future adversary will do it similarly. After observing the SUAS system above its position, they will launch an equivalent or superior system which will attempt to follow the system back to its launch and recovery location. The adversary will attempt to do this by achieving a greater altitude above the friendly SUAS and then observe it as it returns to its POO. If able to observe the system back to the operator, the adversary will be able to conduct ISR of its own which will allow it to reorient its defensive position toward the most likely avenue of approach and to target the static unit with fires to stall or break up the pending attack.

This scenario highlights the gap in the current training that is not conducted with small units during training exercises. An example of the training of this problem set was observed with infantry squads from Charlie Company, First Battalion, Second Marines in Camp Lejeune while they were conducting live-fire deliberate attacks on the Golf 6 range.[74] Each squad was directed to integrate and employ the InstantEye during its attack to confirm or deny assumptions developed in regards to the adversary's disposition on the objective. Each squad leader unanimously employed the InstantEye from the attack or assault position which were both inside one kilometer of the objective. The average time of employment of the system was (25) minutes and every operator flew a direct line to and from the objective under 200 feet AGL to expedite the flight.[75] The mere use of the SUAS was rewarded due to the novel employment method while conducting a deliberate attack even though the information gathered from the InstantEye was rather trivial.

The gathered information was the confirmation of the adversary's location and disposition which was known to a great extent before conducting the SUAS mission, hence the deliberate attack. Traditionally a reconnaissance unit or scout snipers would covertly observe and

report on the objective to provide greater intelligence of the enemy before conducting the attack. With the lack of these units, the overt SUAS mission ultimately hindered the squad's ability to conduct the mission effectively. This is due to the SUAS asset compromising its position to the adversary which is ready and willing to defend its position.

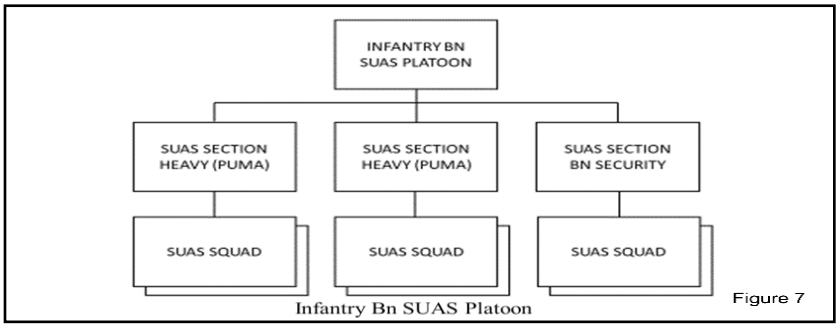
The mission would alert the adversary of the presence of an enemy force within two kilometers (the max range of an InstantEye) and give away any surprise the Marines might have had. Marine Corps Doctrinal Publication (MCDP) 1-3 "Tactics" states that "achieving surprise can greatly increase leverage" and that "surprise can be generated through stealth."[76] The employment of the SUAS in this way spoils the surprise of the attack and ultimately allows the defenders to better prepare for the imminent attack while transferring the advantage away from the squad. The collection of intelligence through the means of reconnaissance is still vitally important for a well-informed attack, but if it is not covert, the risk of losing surprise can spoil the attack.

The use of SUAS in this offensive capacity is with good intentions but has negative results when facing a near-peer adversary. The search for greater situational awareness has an overall degrading effect on the tactical effectiveness of front line units. The "70% solution" is the common goal to make a timely decision and execute an aggressive plan due to the inherent uncertainty of warfare. The use of SUAS should not be used to search for the other 30% of uncertainty if it degrades the facets of Marine infantry units that make them lethal in the first place. MCDP 1-3 emphasis within the six tactical tenets that speed, tempo, surprise, and decisiveness are necessary to gain the advantage against an adversary.[77] The current misuse of SUAS in the offense degrades each one of these attributes and ultimately weakens the combat effectiveness of the small tactical units within the Marine Corps.

Proposed Organization

There are scenarios in which the use of SUAS at the small unit level makes complete tactical sense, but the majority of those scenarios originate from a defensive position to which speed, tempo, and surprise are not necessary tenants for mission success. To solve this offensive SUAS dilemma with the fixed-wing assets, the SUAS needs to be further from the front line while providing the small unit leaders the same amount of elevated situational awareness. A possible solution while keeping Group 1 SUAS at the battalion level is the creation of SUAS units at the battalion level. These units are tasked to support subordinate units from a greater distance away while under the command-and-control of the battalion. The emulation of an 81mm mortar platoon and how it conducts supporting operations to the rifle companies of an infantry battalion is an example that allows for the needed support without the added friction of employment.

The creation of a SUAS platoon that contains multiple assets that provide ISR support to front line units from a location that is beyond the reach of a small adversary unit is a possible solution. The platoon, comprised of three Puma sections that have two squads apiece is able to support multiple rifle companies simultaneously. (Figure 7) This alleviates the command-and-control burden from the company and delivers actionable and effective support. The remaining assets within the platoon allow for the battalion to retain platforms to support battalion specific requirements. This is important to retain assets at the battalion level to accomplish the battalion's collection plan while not detracting from rifle company assets and support.



Infantry Bn SUAS Platoon

Figure 7

The requirement of tablets at the small unit level allows for the video feeds to be transmitted to the small unit leaders. This would allow the small unit leaders and commanders to remain on the move with their unit while observing the feed from the battalion asset rather than being tied to the operator at a static launch and recovery site within enemy range. The ability to remain mobile while gaining the requested ISR allows for commanders and small unit leaders to maintain the momentum, speed, and tempo while either pursuing an adversary or attempting to conduct deliberate offensive action against an adversary position.

The SUAS platoon assets could be requested similarly to the 81's fire supports "target list worksheet." The SUAS is requested through an "NAI list worksheet" which specifies the time, duration, location, and mission of the requested sortie. This would give the information needed to the SUAS platoon to conduct mission planning and assign the appropriate asset while from an appropriate location to best support the requesting unit. This takes the demanding and time-consuming flight planning off of the rifle company, allowing it to focus on conducting its offensive action, which allows for maintaining tempo and momentum without losing the aspect of surprise.

The SUAS from the battalions SUAS platoon would be launched from a greater distance from the front, not under the physical control of the small unit leader while still providing the needed ISR. With each member of the SUAS platoon, a school trained 0231, crossed trained as a SUAS operator, the support is professional and accurate. Conducting SUAS operations in this manner would greatly improve the offensive potential of SUAS by integrating the systems without putting the burden on the rifle companies. The rifle companies now will be able to focus on the mission at hand while being supported by its higher command. They will not have to remain static during the flight of the SUAS, and the flight pattern of the SUAS does not originate

or terminate at their location which would not lead the adversary SUAS to its location. This will ultimately make the rifle company a more lethal fighting force as it gets the required support from a well-trained, MOS qualified SUAS operator while they can focus on closing with and destroying the enemy.

Conclusion

In the Foreword of *UAS Operations:MCRP-3-20.5*, Lieutenant General Robert S. Walsh states that "unmanned aircraft systems are the persistent link and combat multiplier that allow the MAGTF to improve its situational awareness and achieve timely combined arms effectiveness."[78] Although this is undoubtedly the goal of all UAS to include SUAS, the integration and employment of Group 1 SUAS within Marine Corps infantry battalions has not produced the desired results of a more lethal fighting force. This is due to the lack of comprehensive DOTMLPF derived and tested capability solutions created to provide an environment for the seamless integration and employment of all SUAS platforms. Dr. Colin Gray explains how future war demands change within US military "doctrine and practices," which can take decades to change while equipment comes and goes.[79] Embracing future war concepts and integrating new technology within front line troops needs to be accompanied with flexible and adaptable DOTMLPF solutions.

As outlined throughout this paper, there are multiple aspects within the DOTMLPF spectrum that need updating to best set the conditions for the seamless utilization of SUAS within Marine infantry battalions. (See Table 2) The possible near-peer adversary of the future battlefield is currently preparing for the fight; the Marine Corps must meet them with not only superior technology, but with fully integrated technology. The fully integrated technology will

ensure the Marine Corps maintains tactical dominance through sound employment techniques that enhances the lethality of the force at large.

Proposed SUAS DOTMILPF Solutions			
	Current	Problem	Proposed Solution
Doctrine	- T&R Manual (NAVMC 3500.107A – 2014)	- No tasks that cover operational integration - No tactical employment guidance for small unit leaders and commanders	- Updated T&R with Maneuver/C2 integration standards - Tactical Handbook for SUAS operators/small unit leaders/Commanders
Organization	- VTOL systems at squad level - Fixed wing systems sporadically issued throughout battalion	- No standard organization - Does not enable ground force commanders with responsive ISR from Bn level	- Current VTOL systems remain at the squad level - Fixed wing systems (Puma) located in H&S company in a Heavy Plt to support companies - Wasp/Raven remain at company level
Training	- 10-day TALSA course for SUAS operators	- No training for small unit leaders or commanders (See Leadership and Education) - Limited tactical integration training	- Incidental operators course for infantrymen - 0231 (intel analysist) obtain secondary SUAS-O MOS with emphasis on tactical operations - Tiered courses for leadership tasked with employing SUAS
Materiel	- TALSAs maintain all control of maintenance and replacement parts	- Disjointed supply chain to obtain replacement parts for all SUAS platforms	- All materiel integrated into the GCSS-MC to streamline replacement and repair parts
Leadership and Education	- No training or education for leadership	- Small unit leaders and commanders are not educated in the integration and employment of SUAS	- Squad leaders/Platoon commanders receive exposure during entry-level training (IULC/IOC) - Squad leaders/Platoon/Company/Bn commanders receive integration and employment classes respective to billet
Personnel	- Infantrymen are primary SUAS operators - 0231 (intel analyst) have limited role	- Infantrymen are overly burdened and not sufficiently trained - Limited number of 0231 (intel analyst) to support Bn/Co/Plt operations	- 0231 (intel analyst) obtain secondary SUAS-O MOS and become primary SUAS operators - Infantrymen become incidental operators
Facilities	- Installations not able to realistically support SUAS operations - Lack of standards for training installations	- Current installations restrict realistic training exercises do to restrictive SOPs - Units are required to unrealistically pre-plan SUAS operations	- Installations modify training areas and range SOPs to include the use of "unplanned" SUAS into maneuver exercises - Installations require less control within training areas and obtain more RF frequencies to ensure each unit has ability to utilize SUAS

(Table 2)

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