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TITLE: Historical Study of Air Defense and Air Control Units in the Battle of Okinawa

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AUTHOR: MAJOR BELINDA JAROLIMEK

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Executive Summary

Title: Historical Study of Air Defense and Air Control Units in the Battle of Okinawa

Author: Major Belinda Jarolimek, United States Marine Corps

Thesis: This paper exposes critical lessons learned from the air defense and air control units during the Battle of Okinawa in 1945 that remain relevant to 21st century amphibious operations. This historical analysis explores potential concepts of operations for the Marine Air Command and Control System (MACCS) to achieve agility, survivability, battle management efficiencies, and scalability necessary to meet the demands outlined in *The Marine Corps Operating Concept.*

Discussion: The Battle of Okinawa marked the last major battle of the Pacific war and served as the culmination of lessons learned in the Pacific campaign. It was the largest Naval battle planned and executed in history, the largest amphibious assault executed by a Joint force in the Pacific campaign, and the single costliest battle of World War II (WWII).[1] This paper analyzes Marine Corps air defense and air control units that enabled the Naval Expeditionary Force to declare victory at Okinawa in 1945. At a period in time when innovation was rampant, these newly formed units shall be remembered for the trials and tribulations of introducing revolutionary technology and tactics that emphasized the responsibilities of air warning squadrons, quality of fighter direction, and better integration of aviation and ground offensive units.

Conclusion: The critical lesson learned from the air defense and air control units during the Battle of Okinawa that apply to the 21st century are as follows:

- Blended Navy, Marine Corps, and Army staffs deemed critical to bring the full weight of the Joint force to bear against the Japanese.

- The ability to fight on or off ship was necessary to adapt to the ever-changing situation.

- Land based command offered the flexibility and agility needed to synchronize all elements of the expeditionary force ashore and operate seamlessly across the littorals.

- Hanging on to command simply for the lack of air superiority was not a necessity as proven by the effectiveness of the Air Defense Control Center ashore.

-Interoperability across the maritime and allied Expeditionary Naval Force was necessary to maintain tempo and share situational awareness reducing tactical surprise.

-In amphibious operations, sensors must be considered maritime assets and teamed with available naval assets. Detailed, naval plans must include radar siting and emplacement considerations as a primary naval task force objective. The speed and agility of these units was the center point for land and maritime force protection and enabling actions.

-Seamless integration across the littorals between air defense controllers, AAA units, and aviation assets was necessary to maximize force protection and firepower.

-The fight for air superiority and maritime interdiction in support of the Naval Expeditionary Force created tension between the Marine Corps' desire for Marine aviation close air support and the necessity for aviation to support high priority missions.

- Naval forces require a streamlined approach to air support request processes to outpace the multi-domain threats. The success to a multi-domain environment was requires well-synthesized battle knowledge.

Navy and Marine Corps aviation command and control communities must reflect on the lessons learned from the Battle of Okinawa in order to drive down the future risks associated with fighting a peer or near-competitor in the littorals. Reflecting on the tactical successes and failures allows the naval force as a whole the opportunity to posture itself accordingly to meet the demands outlined in Naval and Marine Corps future operating concepts for 2025.

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DISCLAIMER

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

This paper analyses Marine Corps aviation air defense and air control units that enabled the Naval Expeditionary Force to declare victory at Okinawa in 1945. At a period of time when innovation was rampant, these newly formed units shall be remembered for the trials and tribulations of introducing revolutionary technology and tactics during a time of war. My desire is not only for self-study, but of education for those Marines continuing to shape this journey. I hope to inform senior leaders across the Navy and Marine Corps developing future Naval and Marine Corps operating concepts, as well as, inspire innovation for aviation command and control Marines currently undergoing a period of significant technological transition. I hope this is one of many efforts to document case studies for the aviation command and control Marines to further our professional education and understandings of our organizations.

I would like to personally thank Lieutenant Colonel Mark Murphy and Lieutenant Colonel Charles Duke (ret.) who first inspired me to study the history of aviation command and control. Thank you both, gentlemen, for access to the incredible aviation research you collected throughout the years. Best of luck to you both as you continue working on your book. My thesis advisor, Dr. Craig Swanson, also deserves my deepest gratitude. His vast knowledge and insight of the Pacific campaign was instrumental to my understanding. Most dearly, I wish to thank my husband, Clayton, who encouraged me throughout this process, and my sons, Hudson and Henry, who waited patiently by my side as I worked throughout the weekends. Finally, I dedicate this paper to my Grandfather Henry Russell Miller who served on the *USS Rall* at the Battle of Okinawa and nearly gave his life after being thrown overboard after *kamikaze*s attacked his ship. Had it not been for this study, I never would have understood the circumstances leading up to that day.

Introduction

In 1945, allied forces continued their drive across the Pacific Ocean. The Marine Corps having fought long, hard battles in the Pacific was well seasoned and battle hardened. The naval team's amphibious doctrine was refined and thoroughly tested. The Battle of Okinawa marked the last major battle of the Pacific war and served as the culmination of lessons learned in the Pacific campaign. It was the largest naval battle planned and executed in history, the largest amphibious assault executed by a Joint force in the Pacific campaign, and the single costliest battle of World War II (WWII).[2] The Okinawa campaign provided the first large-scale opportunity for highly trained Marines to demonstrate their conception of tactical aviation and ground support, and was a fitting climax for intensive operations devoted to attaining excellence in tactical aviation.[3]

The command structure included an allied Joint Task Force created specifically for the unique relationships envisioned for this campaign.[4] Major General Roy S. Geiger, Marine aviator, commanded III Marine Amphibious Corps and later went on to command the 10th Army for a short period of time. Marine Major General Francis P. Mulcahy commanded the 10th Tactical Air Force including all tactical, land-based Navy, Marine Corps, and Army aviation assets. Marine Brigadier General William J. Wallace commanded the first Air Defense Command (ADC) overseeing the employment of five air warning squadrons. Marine Colonel Vernon E. McGee commanded three Landing Force Air Support Control Units (LFASCUs) newly organized and equipped specifically for this campaign to assume air control and direction of all close air support aviation. Marines were key enablers of an integrated naval team directing air defense and air control units from afloat and ashore. Having phased air control ashore during the largest amphibious operation of the Pacific campaign, Marine air defense and air support

controlled all the airspace over Okinawa despite command remaining afloat for the first 47 days.[5]

The Battle of Okinawa marked the largest deployment of U.S. land-based radars during WWII to include five air warning squadrons responsible for 180,000 square miles of airspace. The perfection of day and night ground control intercepts contributed to 21 new aces; the second highest scoring battle for Marine pilots who maintained 120 to 1 ratio over Japanese pilots. Only four Marine pilots were known to been shot down by the Japanese Air Force during the battle.[6] Marine air support control units controlled over 485 square miles across the 10th Army front facilitating integration of all air and ground units. Close air support represented the best precision of all Central Pacific campaigns.[7] The command system was complex, and appeared somewhat cumbersome, but deemed effective for a battle this size. The control system, which evolved across the Pacific, proved flexible enough to handle operations on this increased scale. Despite effectiveness, air support received mixed reviews from supported units.[8]

As defenders, the Japanese offered no respite during the final fanatical battle for Japanese honor. Enemy air raids varied in size from 45 to almost 200 aircraft. Although the Navy established a defensive perimeter, the sheer volume of enemy aircraft allowed a few Japanese planes to get through. 30 ships of the supporting forces sank and 223 damaged.[9] Japanese ground forces on the other hand anticipated the landings on Okinawa. Roughly 55,000 troops spent four months on Okinawa preparing for an allied attack. Japanese forces pulled back into strong dug in defenses mostly concentrated on the north end of the island. [10]

The Battle of Okinawa reflects the defining point for Marine air and ground integration in what became the core foundation of the present day MACCS. This case study comes during another pivotal point in Marine aviation history. After twenty years of innovation, April 2017, marks the beginning of a new era as Marine Air Control Groups (MACGs) begin significant

technological advances with the fielding of Common Aviation Command and Control System (CAC2S), AN/TPS-80 Ground/Air Task Oriented Radar (GATOR), and Composite Tracking Network (CTN). Along parallel efforts, the Navy and the Marine Corps recently began efforts to redefine expeditionary advanced base operations in contested, littoral operations. This paper exposes critical lessons learned from the air defense and air control units during the Battle of Okinawa in 1945 that remain relevant to 21st century amphibious operations. This historical analysis explores potential concepts of operations for the MACCS to achieve agility, survivability, battle management efficiencies, and scalability necessary to meet the demands outlined in *The Marine Corps Operating Concept.*

Battle of Okinawa

By April 1945, allied forces were in the final stages of the Pacific campaign. The strategic air campaign initiated bombings on mainland Japan, and the Naval blockade enforced blockades of critical supplies and resources. Ground forces reached the Philippines having secured Marianas, Guam, Tinian, and Saipan. Naval Expeditionary Forces operated in the Ryukyu Islands that lay 800 miles south of Japan. The island chain consists of eight large islands and twenty smaller islands. The largest of the islands, Okinawa lay 360 miles from Japan and is roughly 60 miles long and between 2 and 18 miles wide. Having consolidated forces, the allied Joint Expeditionary Forces prepared for the last major battle before the planned invasion of Japan.[11]

Japan having lost a large portion of her naval fleet could feel the U.S. closing in on her. Japan's Imperial Air Force was in a desperate situation although it still possessed a comparatively large air force able to easily range Okinawa from mainland Japan, Formosa, and China's coastline.[12] For the Japanese, death was preferable to defeat. The *kamikaze* was the last

desperate effort to prevent a U.S. invasion. Lieutenant General Mitsuru Ushijima, the Japanese officer charged with defense of Japan, realized his only hope was the Kamikaze Special Attack Force. The Japanese *kamikaze* had three objectives: 1) eliminate of the outer screen radar picket ships 2) destroy combat naval forces covering the operation 3) destroy troop transports, cargo ships, and other elements supporting and supplying amphibious forces.[13]

Campaign Objective

The Battle of Okinawa, codenamed Operation ICEBERG, set April 1, 1945 as L-Day. The campaign contained five objectives: 1) establish bases from which allied forces could attack Japan and its naval and air forces 2) support further operations on East China Sea 3) sever Japanese sea and air communications between Japan and Asia, Formosa, Malaya, and East Indies 4) establish secure sea and air communications through East China Sea and 5) maintain pressure on Japan.[14] The allied forces required a sizeable strategic base with multiple airfields to continue the fight to mainland Japan. Their biggest challenge lay ahead if they wanted to reach Japanese homeland.[15]

Command Structure

The command structure included an allied Joint Task Force created specifically for the unique relationships envisioned for this campaign. Navy Admiral Chester William Nimitz, Sr., Commander in Chief U.S. Pacific Fleet, designated Navy Admiral Raymond A. Spruance of 5th Fleet, as Central Pacific Task Force Commander. The Joint Expeditionary Forces Commander was Navy Vice Admiral Richmond K. Turner. Army Lieutenant General Buckner, Jr., U.S. Army 10th Army Commander, was designated the Commanding General Expeditionary Troops. Army Major General John Hodge, commanded XXIV Corps with two divisions, and Marine Corps Major General Roy Geiger commanded III Amphibious Corps with two divisions.

Subordinate to 10th Army was 2d Marine Division as a demonstration force, 27th Infantry Division (Army) as the floating reserve, 77th Infantry Division (Army) as western island landing force.[16] Subordinate to 10th Army was the Tactical Air Force (TAF) commanded by Marine Corps Major General Mulcahy. His air forces included all land-based aircraft at the objective area. Overall direction of air forces remained with the Commander Expeditionary Forces exercised through the Commander Air Support Control Unit (CASCU) afloat until the Commander Expeditionary Troops assumed responsibilities. At that time, TAF assumed air direction and air control of land-based aircraft.[17] The total Joint Expeditionary Force included 5 divisions, 1,457 ships, and just over 1,000 aircraft.[18]

The Tactical Air Force command's initial disposition was aboard the *USS El Dorado* and the Air Defense Command aboard *USS Allendale.* Once ashore, the TAF Headquarters, augmented by U.S. Navy and Army personnel, established their Headquarters in the vicinity of Yontan and Kadena airbases next to the 10th Army Headquarters. Their mission:

> 1) Establish headquarters and tactical units ashore as soon as practicable after L-Day
> 2) Execute the air support mission assigned by the Commander, Joint Expeditionary Force, as long as he functions as such in the area
> 3) Provide air defense and air support for the ground and supporting surface forces in Okinawa by application of available air power as dictated by the overall situation and as directed by higher[19]

2d Marine Aircraft Wing Headquarters became the nucleus of the 10th TAF. The Headquarters comprised 112 officers (60 USMC, 24 USA, 28 USN) and 398 enlisted men (378 USMC, 20 USN corpsmen).[20] Half of the staff embarked for the assault and the remaining staff joined them one month later. As foreseen by General Mulcahy, operating so close to Japan meant the enemy could throw everything possible at the fight. For this reason he selected an Air Defense Commander, his former Air Fleet Marine Force Pacific Chief of Staff, Brigadier General Wallace, whose sole purpose was to stop the *kamikaze* from attacking.[21]

Figure 1: 10th Tactical Air Force Organization. [22]

III Amphibious Group

(Major General Gieger, USMC)
Signal BN
*LAFASCU 1

10th Tactical Air Force
(Major General Mulcahy, USMC)

Air Defense Command (Fighter Command)
(Brigadier General Wallace, USMC)
HEDRON 43
AWS-1
AWS-6
AWS-7
AWS-8
Co. B 568th Signal Air Warning Bn (USA)
Det. 305th Fighter Control Squadron (USA)

Marine Air Group 31	Marine Air Group 33	Marine Air Group 22
(Colonel Munn, USMC)	(Colonel Dickey, USMC)	(Colonel Torrey, USMC)
HEDRON 31	HEDRON 33	HEDRON 22
SERON 31	SERON 33	SERON 22
VMF 224	VMF 312	VMF 113
VMF 311	VMF 113	VMF 314
VMF 441	VMF 332	VMF 422
VMF(N) 542	VMF(N) 543	

301st Fighter Squadron
HQ and HQ SQDN 301st Fighter Wing

318th Fighter Group
(Colonel Sander, Air Corps)
364th Air Service Group
19th Fighter Sqdn
73rd Fighter Sqdn
333rd Fighter Squadron

*LAFASCU 1 – Co-located with III MAF HQ (Col Kenneth Weir)
*LAFASCU 2 – Co-located 10th Corps HQ (LtCol Kenneth Kirby)
*LAFASCU 3 – Co-located with 10th Air Force (Colonel Avery Kier)
*LAFASCU technically were outside of the TAF chain-of-command reporting directly back to CASCU, Phibs PAC aboard Admiral Turner's flagship.

Source: 10th Tactical Air Force Operations Plan No. 1-45

Phasing Control Ashore

Japanese resistance to III MAF landing on Okinawa was light. Before dark, 50,000 men established a beachhead. Yonton and Kadena airfields were seized by 1230 on (1 Apr) L Day. [23] TAF went ashore on L+2 and setup between the two airfields. ADC followed and setup nearby. Because of the lack of air superiority, air defense command remained with the Navy. The afternoon of L+6, Air Defense Control Center (ADCC) became operational from three amphibian tractors specially equipped with power and communications gear and a plotting room.[24] Air defense control executed ashore despite the fact that command remained with the Navy. TAF assumed administrative command of assigned subordinate units, but tasking remained with the CASCU afloat in accordance with requirements of the naval situation and the desires of 10th Army. It was not until 17 May when tactical command for III MAF phased ashore. [25]

Establishing Command Ashore

As anticipated, the Japanese subjected U.S. ships and troops to the most concentrated and intense air attacks in the Pacific. The Naval Expeditionary Forces, including U.S. carriers, committed to the occupation of a territory within easy range of a wide variety of enemy, land-based aircraft. Destroyers stationed on picket duty suffered the greatest losses while ensuring the protection of ships and troops at the objective. A total of 560 raids consisting of 2,228 planes attacked the objective area. Of those raids, 331 were at night employing 622 planes, while 229 day raids employed 1,606 planes. Allied forces destroyed 1,438 enemy planes by combat air patrol (CAP), AAA, or enemy dive attempts (*Kamikaze).* Intelligence estimated the allied force destroyed 1,300 planes in the daylight. Over 80 percent of all enemy planes attempting to attack the objective were killed and approximately 60 percent shot down by CAP. On a side note, the

relative smaller numbers for carriers reflect its southwestern sectors for patrol.[26]

Table 1: Enemy Aircraft Destroyed By Unit Type. [27]

Carriers and Light carriers	474	Total sorties	
Carrier Escorts	563	Day	15,348
Tactical Air Force Marines	256	Night	647
AAA and suicide dives	645	Radar Picket	1600
Total	1438	Total	17,595
Prior to L-Day kills	92		

Source: Chief of Naval Operations, *Combat Information Center* 2, no.8 (August 1945).

Maintaining the fight for the airfields (Yontan and Kadena) under unusually hard conditions became an obstacle for expeditionary forces as the combination of Japanese bombing and strafing, enemy artillery, fragments from friendly antiaircraft shells, heavy rains and, foul weather slowed construction of the airfield and made air operations hazardous.[28] The most audacious Japanese attack on the Yontan airfield occurred on the night of 24 May. Four Mitsubishi Ki-21 (heavy bomber) aircraft each carrying 14 Japanese troops armed with grenades and demolition equipment approached Yontan airfield. AAA units located on the airfield shot down three out of four planes. The fourth made a wheels up landing and 8-10 Japanese ran out and started throwing grenades at parked planes. The Japanese soldiers destroyed 7 friendly aircraft and damaged another 25. Ground crews immediately killed three Japanese soldiers while eight other Japanese were shot on the airfield. Fatalities included one officer and one enlisted killed with another 18 personnel injured.[29]

Command Structure Lessons Learned and Assessment

The Strength of a Joint Force. The Battle of Okinawa reflects why it is so important to tailor the command and control structure based off the real-time situation. This approach and lessons learned highlighted many service constraints across the naval force and added to the heated aviation debates following the war. From an operational level, the barriers of service

parochialism, while forcing difficult decisions after the war, did not hinder the Battle of Okinawa, rather was one of the successes. Aviation assets scattered widely across multiple services and allied nations came together under local commanders responsible for implementing plans that were both timely and effective against the enemy. Japanese forces could not prevent the seizure by a combined Navy, Army, and Marine force.[30] Great leaders such as Generals Gieger and Mulcahy shattered the traditional service parochialism to take the fight to the enemy. The idea of a Marine general in charge of an Army Corps headquarters was unthinkable at the time. A Marine general establishing an air defense command is somewhat difficult to imagine today as the Air Force traditionally fills this role. The Battle of Okinawa is a great example of strong Marine generals capable of bringing full capabilities of the Joint force to battle. This is an incredible lesson that speaks to the reason why the Marine Corps maintains the ability to serve as a Joint Force Air Component Commander in doctrine today. Marine leaders should understand the approach taken at the Battle of Okinawa and not automatically default to one service. Service parochialism should never paralyze efforts to defeat the enemy.

Phasing Command and Control Ashore. Phasing command and control ashore was a slow and laborious process. The lack of air superiority plagued the fleet slowing down the operational tempo and rendering their ability to phase command ashore according to planned timelines. The idea of air superiority being tied to phasing command ashore tested and inhibited the momentum on the island. Because air superiority was never achieved, coupled with the fact that the ADCC did not have the means to command and control forces ashore for the first two weeks, complicated the command and control structure. While somewhat effective and deemed necessary at the time, it was not ideal for the forces ashore. Depending on the situation, maintaining command ashore despite achieving local air superiority is an option once the ability

to command and control exists. Hanging on to command simply for the lack of air superiority is not a necessity as proved later by the effectiveness of the ADCC ashore.

Recommendations for Future Enhanced Amphibious Operations 21st century

The framework outlined for enhanced amphibious operations in the 21st century is *The Marine Corps Operating Concept (*MOC). The lessons drawn from the Battle of Okinawa reinforce the Commandant of the Marine Corps, General Neller's, approach to future conflicts in the 21st century. When conducting littoral operations a unified command structure subordinate to the Navy as part of a combined/Joint force promotes unity of effort in the littorals.[31] This is the same approach employed in the Battle of Okinawa. Integrated staffs with the ability to fight on or off ship were necessary to adapt to the ever-changing situation.[32] Land-based command offered the flexibility and agility needed to synchronize nearly all elements of the Joint force once ashore. Without an integrated staff ashore and afloat, synchronization of disparate assets would not come to fruition. A unified purpose, unified objectives, and unity of effort allowed seamless operations across the littorals.

A common integrated naval command and control system is needed to share situation awareness across all components of the Naval force.[33] During the Battle of Okinawa, shared awareness across the naval force relied primarily on voice communications. This often came at the expense of overwhelmed voice circuits. A common situational awareness system such as CAC2S is needed to instantaneously share awareness and should not rely purely on radio circuits. Interoperability across the maritime and Joint force is necessary to maintain tempo and create shared understanding and reduce tactical surprise. A common system enables integrated staffs and affords the opportunity for agile command and control organizations able to fight on and off ship, as displayed at Okinawa, without significant hindrance from command and control systems. Maintaining a fluid environment enables agile organizations. This now becomes a

people focused organization vice stove-piped skillsets necessary to operate distinct Navy or Marine Corps weapon systems. This allows applying the right person, to the right location, at the right time.

The Battle of Okinawa demonstrated the inherent flexibility of amphibious operations. The ability to maintain command and control ashore or afloat built a level of redundancy necessary in littoral operations. In the future, more should be done to apply this same level of integration with the carrier fleet. The strength of carrier aviation was not fully realized in the local area. Largely carriers were held in the southeast corner of the area of operation in more of a reserve capacity than what was planned for in the operation. The flexibility afforded by an integrated Naval staff allowed synchronization across the area of operations. Had an integrated Naval aviation staff ashore existed, many of the parochial fights of Marine aviation predominantly supporting fleet defense while carrier aviation supported close air support might have been rectified. Increased flexibility to integrate carrier aviation seamlessly across the littorals is needed regardless of command afloat or ashore.

Air Defense

The Okinawa campaign was the first opportunity for coordinated employment of the largest number of Marine air warning squadrons. 1,500 Marines, including five air warning squadrons, were responsible for 180,000 square miles of airspace. These units provided air warning for allied forces in the Ryukus and day and night fighter direction on Okinawa. The expeditionary employment of new radar and radio equipment proved to be a contributing factor in the aerial success of Marine aviators. [34]

Air Defense Plan

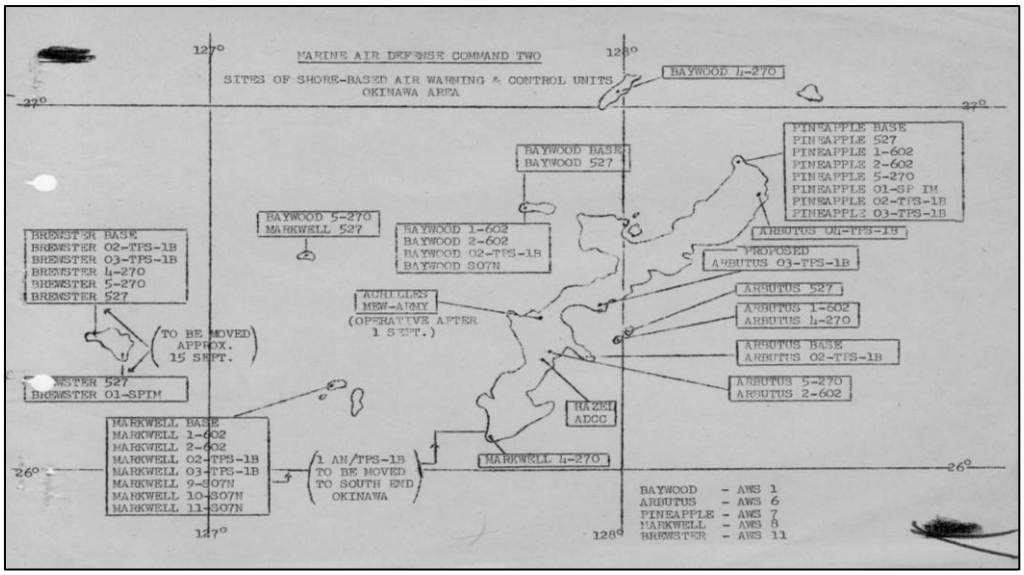
ADC, callsign “Handyman,” was responsible for the direction of air defense, air control,

and antiaircraft artillery units ashore. ADCC, callsign "Hazel," directed the defense of the area including local shipping against enemy air operations. In conjunction with the Navy, the ADCC set the air raid warning conditions, established AAA guns and automatic weapons status (both ship and shore base) and controlled seacoast searchlight operations. The air warning and fighter direction units were subordinate to the ADCC and responsible for controlling and operating radars ashore.[35] The air warning and reporting system consisted of five semi-independent air warning squadrons (AWSs) responsible for radar spotting stations and the outer screen of Okinawa. The air defense network consisted of 28 stations, phased in over a two month period, including 6 ground control intercept stations strategically located on Okinawa and 5 outlying islands.[36] Prior to establishment, the Navy maintained radar fighter director ships to act as pickets and give early warning of approaching enemy raids, as well as direct intercept missions. Some eight or nine picket stations typically comprised of two destroyers each, augmented by LCSs and LCM(R)s to aid in AA fire and tow disabled destroyers to safety. The stations formed control groups placed under a senior controller stationed in the air control headquarters afloat. In additional to traditional combat air patrol, a new term called "picket patrol" was necessary as the battle continued. Each picket had two planes under its control for immediate protection plus other fighters for normal intercept missions.[37] The system was as follows: the Tactical Air Commander (afloat) made daily estimate of the situation based off enemy intelligence. He informed the ADC of the recommended number of planes required for CAP. ADC assigned subordinate squadrons to CAP and picket missions. ADC provided the senior controller the schedule of assignments. Once airborne, fighter aircraft radioed in to the senior controller, who then assigned them to various picket stations. If a raid developed into a large enough size, the senior controller "scrambled" fighters on ground standby status. This system was the same for

both day and night missions. The command and control system planned was the most elaborate in the Pacific.[38]

Control and fighter director units consisted of sub-ADCCs and GCI stations. The GCI stations reported control statuses directly to the ADCC. ADCC mission assignments included: control of CAP and missions of interception or investigation, homing of lost aircraft, assistance in air-sea-rescue operations, control, tracking, or clearance of strike missions, clearance of transient aircraft, and assistance in searchlight operations.[39] Overtime, the ADCC became the best instrument to keep the ADC informed of the tactical situation. The ADCC best represented the Navy's Combat Intelligence Center (CIC) at the time. Today, it is the equivalent of today's Marine Corps Tactical Air Operations Center. Figure 3 outlines the shore-based air warning and control units in Okinawa.

Figure 3: Sites of Shore-Based Air Warning and Control Units Okinawa Area as outlined in the Tactical Air Force Operations Plan.[40]



Source: Tactical Air Force Operations Plan 1-45

Antiaircraft Artillery Plan. Antiaircraft artillery and seacoast artillery provided AAA defense

of ports, major ground units in landing and deployment, beach operations, defense airfields, port facilities, and major military installations. Naval coast units supported defense of landing beaches, harbor defense for major ports, naval bases and fleet anchorages, and supplemented field artillery direct-fire support, as directed. III Amphibious Corps AAA units provided defense for Corps units and installations, Corps beaches until relieved, and captured airfields in zone of action until relieved. Until the 53rd AAA Brigade assigned area of responsibility (AAOR) was established ashore, the AAA units in III Amphibious Corps and the XXIV' Corps operated directly under the operational control of the Navy CIC. The 1st Provisional Marine Group normally operated in its AOR and prepared to assume the functions of the Brigade AAOR in the event the latter was destroyed. In such a case, the senior AAA commander present disseminated his orders through the 1st Provisional Marine Group AAOR. The commanding officer, 1st Provisional Marine AA Group coordinated the disposition and operation of all-Marine early warning radars in order to provide maximum surface and low angle radar coverage.[41] Responsibility for air defense resided with the Commander of Joint Expeditionary Force, exercised via the Commander ASCU through the Force Fighter Duty Officer (FFDO). The FFDO was responsible for air defense during the initial phases of an amphibious operation and exercised operational control over all antiaircraft artillery from the CIC aboard the Headquarters ship until the ADCC assumed control ashore. The responsibility for air defense passed from the Commander ASCU to the ADC ashore once directed by the Commander Joint Expeditionary Force. The air warning facilities of the FFDO was available to the air defense commander ashore. He exercised his operational control from the ADCC through the commanding officer, 53rd AAA Brigade. [42]

Enemy Tactics

The enemy employed "window" (equivalent of chaff) in all sectors between 20 to 100 miles in distance giving false targets to U.S. radars. Some resistance to radar electrical jamming occurred. Neither activity seriously hampered operations. At times, a jamming station at Yoron Shima, best described as a balloon with streamers, gave the appearance of several aircraft at various different altitudes. Japanese deception tactics were inconsistent and appeared at altitudes from the deck to 20,000 ft. The majority occurred between 4000-8000 feet. Prior to raids, Japanese aircraft proceeded at erratic headings for the perceived purpose of drawing off friendly fighters and potentially confusing fire control systems. At night, it was obvious the enemy knew night fighters were in the area despite pilots turning off IFF and VHF transmissions. The enemy employed violent evasive actions, dropped window, and varied altitude. The enemy understood radar limitations as demonstrated by decreasing altitude and using "geography" null areas when approaching. Japanese used VHF for deception calling themselves "Ringtail" and attempting to vector U.S. fighters.[43] Marine pilots and air intelligence officer described Japanese tactics of "high caliber closely resembling U.S tactics."[44] The enemy typically attacked in divisions and sections. They attempted to drag planes into their antiaircraft batteries and believed to use colored burst to assist AA units in marking altitudes.[45] It was noted in June 1945, that the Japanese took advantage of the limitations of ship radars when they were operating in restricted areas near land. Japanese pilots conducted suicide attacks from many directions when land afforded protection understating radar scoped would be cluttered with echoes from land masses.[46]

Air Defense Lessons Learned and Assessment

Radar Planning and Emplacement. In amphibious operations, sensors must be considered maritime assets and teamed with available Naval assets.[47] An important lesson from the Battle

of Okinawa was the necessity to first secure and seize optimal radar sites. Night radar intercept was disappointing averaging two kills per week. Admiral Halsey expressed his dissatisfaction with shore-based radars.[48]

> As long as land-based radars failed to provide required intercept information, picket ships-not handicapped by land mass interference-had to stand out front and bear the brunt of the suicide attacks (16 of 19 original picket ships hit). Matters were soon straightened out. The chief trouble lay not in the radar's technical performance, but in the short range for voice communication at night over the land mass and in the siting of the sets-to which the high command had paid too little attention. Admiral Spruance put his finger on the deficiency: It is recommend that in planning all future operations much greater emphasis be placed on securing outlying land areas or islands at the earliest practical date and installing adequate land-based radars and fighter director units thereon in order that vulnerable shipping will have to remain exposed stations no longer than absolutely necessary. The improvements of night fighting techniques was a notable improvement on Okinawa. Radar equipment of the AWS's established 14 points on Okinawa and outlying islands. [49]

The choice locations should be made from all available islands. Land-based, long-range radars were necessary for appropriate early warning for the entire naval force. Light-weight, land-based radars were critical in phasing ashore to ensure the success of the assault. Particular attention must address siting considerations that not only allow for mutual support of land-based and sea based-radars, but also take into account the ability for ship-to-shore communications. As somewhat expected from newly introduced technology, radio and radar failed too often. The weakness, however, was a result of the lack of radar planning and emplacement more so than it was the result of equipment failures. The lack of advanced radar planning and emplacement resulted in the loss of numerous picket ships. A detailed, naval plan must include radar siting and emplacement considerations as a primary naval task force objective.[50]

Picket Ship Integration. Picket ship integration was the highlight of the campaign according to the 5th Amphibious Force and ADC after action reports.[51] Airborne early warning pickets provided additional coverage around the island of Okinawa.[52] While the plan failed to address

the immediate installation of radar assets ashore to help protect the vulnerable ships operating in restricted waters, it did compensate for the disadvantages associated with ship-based radar such as the lack of altitude and the impacts of land-based, coastal clutter. Integrating Naval assets into the plan strengthened the air defense network and prevented the overwhelming casualties inflicted by *kamikaze* pilots. The Navy's biggest challenge was the ability to maintain 24/7 coverage of fighter controllers capable of integrating air, land, and sea air defense. Not having a night watch, for example, made it problematic for land-based air defense units to report early warning of enemy aircraft.[53]

Shared Awareness. Initial coordination with units proved challenging until additional communications equipment came ashore. As with previous battles in the Pacific, it took longer to establish shore based air defense units than originally planned. Prior to the ADCC establishment, individual radar stations reported directly to the *El Dorado* via voice communications. Shore-based fighter direction units were an integral part of the air defense system. Once the ADCC was ashore, coordination went smoothly and all shore-based units reported via ADCC.[54] The ADCC maintained situational awareness via radio communications and manual plotting boards. Despite manual plotting of friendly and enemy air assets, the ADCC and *El Dorado* maintained shared situational and a complete air picture in the vicinity of Okinawa. There are numerous examples during the Battle of Okinawa where situational awareness broke down, but the implementation of ADCC ashore drastically improved the situation.[55]

Air Defense Integration with AAA Units. The plan for integration with AAA units was detailed. Engagement authority and direction of units relied with the air defense commander either ashore or afloat. This allowed, in theory, the seamless integration of friendly fighter

aircraft and AAA units and still took into account to ability for AAA units to exercise the right to self-defense if engaged by enemy aircraft.[56] In action, this became problematic. Land-based aircraft ashore were often unaware of friendly ship's location allowing friendly aircraft to follow enemy threat aircraft directly overhead friendly ships. Other times, friendly aircraft flew over ships and battle fatigue fighter directors authorized ship-based AAA to open fire on friendly aircraft. Further complicating the situation was the Japanese *kamikaze* approaches. *Kamikazes* attacked friendly ships with 360 degrees approaches making it even more complicated for AAA gunners. Friendly aviation reported the same challenges with coastal defense units, but soon realized avoiding over flight of coastal units was the best tactic. Once liaisons integrated into the ADCC AAA units reported greater success. Land-based air defense controllers initially withheld AAA when friendly planes overhead regardless of the comparative effectiveness of fights and AAA. However, there were cases when *kamikazes* attacked airfields making it very challenging to avoid all friendly assets.[57]

The fight to maintain air superiority was a challenge. Despite numerous orders, ground units found it difficult to not open fire despite knowing if friendly aircraft were in the area Lessons learned by the Navy recognized battle fatigue, undermanned fighter direction personnel, and combat replacements as contributors to friendly fire incidents.[58] To solve this challenge, the Navy proposed ship rotations and shorter crew hours to decrease the anxiety and mental tension of the AAA units. Regardless the high level of discipline instilled in Navy AAA sailors, this did not negate the larger problem that was the shortage of fighter directors.[59]

The air defense network and the enabling actions of the air defense command and air control squadrons allowed unified action across the entire expeditionary force. The Marine Corps air defense capabilities provided the Expeditionary Force Commander the ability to sense, detect,

track, and target. The speed and agility of these units was the center point for land and maritime force protection and enabling actions. Radar sensing allowed mobility and force protection of the fleet and land based units. Any failures directly resulted in neutralization or destruction of friendly ships. It is likely the enemy will continue to take advantage of land mass clutter forced upon amphibious ships during the initial assault phase. It is imperative to take advantage of all ground-based systems that provide greater fidelity and make use of all possible fire control radars for early warning.[60] Seamless integration across the littorals between air defense controllers, AAA units, and aviation assets is necessary to maximize force protection and firepower.[61]

Enhanced Air Defense Systems. The 21st century enters a new era with the potential for more technological surprises.[62] Wayne P. Hughes, author of *Fleet Tactics*, envisions greater technological surprises as there have been fewer large, naval battles at sea. The surprise of secret weapons such as radar, torpedo, "window" and cryptanalysis in WWII provided technological advantages in battle while the *kamikaze* attacks off Okinawa gave turn to a future missile threat.[63] At the beginning of Pacific campaign, the Navy could not foresee the devastation land-based suicide attacks would have on the fleet.[64] *The Marine Corps Operating Concept* describes future battles in contested areas where competitors hold forces at greater distances and deny the ability to maneuver in the littoral and landwards areas.[65] To implement the lessons learned from Okinawa and better posture the entire naval force, the U.S. Navy and Marine Corps must take full advantage of the technological advances in air defense systems to increase standoff distances and enable naval maneuver.

The Marine Corps Air Control Squadrons (present day version of Air Warning Squadrons) are undergoing significant technological improvements with the fielding of Common

Aviation Command and Control System, TPS-80 Ground/Air Task Oriented Radar (G/ATOR), and Integrated Fire Control System (IFC). For the first time in history, the Marine Corps will have a ground-based, air search radar capable of rapid emplacement with initial operations in 25 minutes. This capability with IFC allows the ability to fuse radar tracks and forward sensor information to participating Cooperative Engagement Capability (CEC) platforms such as U.S. Navy destroyers equipped with Standard Missile 2 and participating aircraft such as the joint strike fighter. This fusing of information allows CEC participating weapons platforms to engage off remote tracks forwarded from early warning radars, drastically increases the standoff distance between radar and shooter platforms.[66] This provides more mobility, agility, and survivability for the fleet. As this relates to the Battle of Okinawa, this newly fielded capability reinforces and potentially complicates the need for advanced radar planning and emplacement while reinforcing the idea that radar assets should be considered maritime capabilities. Theoretically, the newly fielded equipment will provide greater situational awareness via a common tactical picture enabled by tactical data links such as Link 16. What it does not negate is the line of site challenges of voice, radio, and tactical data links required between ship to shore based units. Detailed equipment siting considerations remain imperative.

"Maneuver is tactical speed and agility."[67] "Fleet maneuver must be a collective, coordinated motion, so it is impossible to divorce C2 [command and control] and speed of decision from this discussion…Tradeoffs between the amount of time it takes to establish scouts [radar] assimilate information (C2 systems), decide (trusted networks providing reliable information to decision makers), maneuver (airplane, ships, nodes), and deliver effective firepower (weapons)."[68] The ability to maneuver compensates for other shortcomings. During the Battle of Okinawa, land-based radars did not have this luxury, as equipment sets were still

relatively large and cumbersome. CAC2S and G/ATOR drastically reduce the equipment footprint ashore and increase the speed and agility of air control squadrons.[69] The remaining obstacle to overcome is integrated planning with the maritime air defense commander allowing seamless synchronization of movements that protect both the fleet and land-based forces while maintaining a location that is secure and does not compromise high demand assets. Adaptive air control agencies whether afloat, ashore, or airborne allow seamless integration of sensors, nodes, and maneuver. The adaptive nature of an air defense network to place ships and control nodes in the right place to combat the enemy, while constantly adapting tactics across the entire air defense network, ultimately defeated the remaining Japanese air forces in Okinawa. The introduction of ground-based intercept control turned the table on the Japanese advantages of operating at night tipping the favor to allied forces.

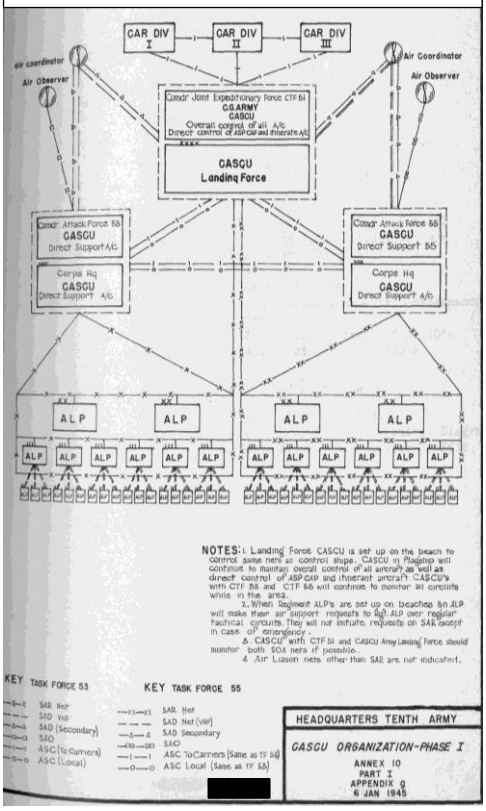
Future amphibious operations must learn from these lessons and build upon the adaptive nature of air control agencies, personnel, and equipment. Common, streamlined tactics, situational awareness systems, and training allow adaptation across the Naval Expeditionary Force. Commonality allows the right person with the right skillset to be placed at the right time with the right capability. Sharing capabilities across naval components has the potential to overcome some of the 24/7 challenges of fighter direction officers and gives the maritime component commander added flexibility and redundancy. There is a great opportunity to train with Navy to build the strongest maritime air defense network ready to defeat future threats in the 21st century.

Air Support

Air Support Plan. The Marine Corps' increased desire for better air and ground integration created the need for a revised air support system. The plan for Okinawa called for 3 LFASCU

units to support 5 Army and Marine divisions covering 485 square miles of land. LFASCU 1, co-located at III MAF command post, was responsible for southern control. LFASCU 2, co-located with XXIV Corps HQ, was responsible for northern control. LFASCU 3, co-located with 10th Army, TAF Headquarters, and served as the Headquarters for Commander, Air Support Control units ashore (Colonel Vernon E. McGee). Colonel McGee reported directly to the Commander, Air Support Control Units afloat (Admiral Price) on the *El Dorado.* LFASCU 3 and the Headquarters provided necessary redundancy and augmentation to forces to the divisions and regiments as required. Air Liaison Party's (ALPs) located with each regiment and battalion. Figure 2 outlines the air support request process.[70] Battalion ALPs relayed immediate requests to the regimental ALP over tactical assigned nets. Only the regimental ALP requested air directly to the LFASCU on the designated air request net.[71] Upon arrival ashore, each tactical aviation unit assigned to the 10th TAF operated under the centralized direction of the commander, support aircraft control unit afloat, in accordance with requirements of the naval situation and the desires of the commander landing force. Once ashore, the TAF commander assumed command of assigned subordinate units, but operated under the direction of the commander of the attack force. Direction of all TAF units passed to the Commander 10th TAF from commander, Joint Expeditionary Force upon assumption of command ashore by the commander, expeditionary troops 10th Army.[72]

Figure 2: 10th Army Air Support Request Process



Source: 10th Army OPLAN 1-45.

Despite planning arrangements, LFASCUs began immediate direction of most close support aircraft once airborne. Immediate requests flowed from LFASCU 3 (10th Army) back to the ship for assignment. During the early weeks of the operation, Marine fighter aircraft were so busy with air defense that mostly escort and fast carriers provided direct support of troops. As the battle continued, TAF played a more significant role with daily aviation requirements. Two escort carriers with Marine air groups onboard arrived during the campaign, but two other Marine carriers did not arrive until after the campaign ended.[73]

The air support request system was an open system based off the needs of the supporting units. Units typically submitted preplanned requests by 1130 daily. Units submitted immediate requested on short notice due to the tactical necessity. By design air support missions should be foreseen in advance and by way of practice typically was not requested if targets were within reach of artillery units. Each corps maintained target information centers with suitable targets for air and artillery in the case if additional aircraft became available for tasking.[74] The majority of air support missions fell into the following categories: a) rocket bombing, straffing, and napalm attacks on ground forces b) attack Japanese craft, supply dumps, troops, rear-area installations c) observation missions d) air supply drops critical supplies front line troops e) evacuation of wounded troops from front lines.[75]

III MAF ground units established priorities based on the published guidelines:

1) Priority air support was to gain the necessary degree of air superiority
2) Prevent movement of hostile troops and supplies into the area
3) Participate in combined effort of air and ground forces in battle area to gain objectives on the ground[76]

Coordination between air support, naval gunfire, and artillery was in the commander air support control unit operations room afloat and in the landing force commander air support control unit's established ashore. Due to the extensive communications requirements, this was

the most practical.[77]

During the Battle of Okinawa, Navy and Marines employed close air support more efficiently than any other battle in the Pacific. This was a direct result of improved communications and better-trained personnel. Between 1 April to 21 June, carrier and land-based assets flew a total of 14,244 support sorties. LFASCUs controlled 10,506 close support sorties by the end of 30 June. Carrier and carrier escorts flew 60 percent of direct air support missions.[78] Close support was praised; however, 6thMARDIV reported bluntly "The basic difference between air support as carried out in the Okinawa operation and that which is desired by this command is that instead of having the ASCU direct the strike group it is advocated that the ALP's be permitted to contact the airplane directly on the SAD [support air direction] net."[79] Later explained by Colonel McGee, "to have permitted each battalion air liaison party to control striking aircraft on a corps' front of only ten miles, when many simultaneous air strikers were being run, would obviously have led only to pandemonium and grave hazard for all concerned."[80] Of the sorties flown in direct support of troops, 10 involved friendly fire incidents.[81]

Air Support Lessons Learned and Assessment

Air and Ground Integration. One of the more significant air support lessons learned during the drive across the Pacific was the desire for better integration of air and ground units. During the Battle of Okinawa, some of the challenges were overcome with newly introduced aviation radios allowing for better air to ground communication. The Marine Corps specifically created LFASCUs and ALPs for this purpose of a centralized air support agency responsive to the needs of the ground commanders. The air support network designed allowed for communication between ALPs and LFASCUs. The two-way exchange of information between the ground units

and LFASCUs became a core element for air support integration. Through voice and wire communications, ALPs provided accurate and timely situational updates on the ground's scheme of maneuver. The LFASCUs co-located with the senior headquarters allowed the ground commander to prioritize aviation requested. From this point forward, Marines and the Joint force would measure success by the ability to effectively integrate air and ground operations.[82] Success of air support varied across the force and was mostly seen as successful. For Marines, it was more complicated than just integration. The desire, as displayed during the Philippines, was for ALPs to provide terminal control of aviation assets. This was seen as a fundamental need for effective air support.[83]

Roles and Missions. The professional debate over land-based versus sea-based aircraft roles and mission erupted after the war. The biggest complaint from Marines was the desire for Marine aviation to execute close air support missions ashore and prioritize this over all other missions. Ground combat units were perplexed as Marine sorties conducted daily strikes against enemy airfields and felt this mission was better suited for strategic air force assets. Marine aviation, while highly successful at maritime interdiction missions and vital to the success of the maritime fight in Okinawa viewed this role as more appropriate for carrier air. Following WWII, this was intensely debated and finally agreed upon by the Joint Close Air Support Board and written into Joint doctrine. Both have their advantages and disadvantages and are best seen as complimentary. This is where service parochialism comes into play. There is a balance between the asset desired and the asset required. This is where an integrated staff with appropriate aviation representation across the force can best look out for the naval organization as a whole.

Fight for Air Superiority. Highlighted to Marines at the Battle of Okinawa was the tension created between aviation and ground units over the necessity for air superiority and the desire for

close air support aviation. Air superiority mostly overruled ground close air support unless there was an extreme situation like a large unit being completely overrun. It is highly likely the tension will exist across Marine aviation during times when air superiority is unlikely. Education of ground troops and flexibility by air support agencies is key to make this as seamless as possible. Marine rotary wing aviation becomes a critical enabler for close air support and a potential balance if the situation allows. Additionally, standardized joint close air support tactics and techniques assist with the barriers presented at the battle by close air support effectiveness by different services. The air support request process developed for the battle broadly reflects the present day system. Techniques and tactics certainly improved over the decades, but the air support organization and the processes for submitting Joint Tactical Air Strike requests remain today.

Evolved Air Support System. The air support system employed in 1945 despite name changes largely reflect the same air support procedures developed and refined in WWII. The system described as centralized command and decentralized control is largely hierarchical in nature. Requests flow from subordinate units via their higher command post echelons to a centralized agency today called the Direct Air Support Center (DASC). Units have the means to reach out directly to the DASC with a silence as consent approach by their higher echelons of command. Preplanned requests submitted anywhere between 48-72 hours in advance are still constrained by the ground units ability to foresee the need for aviation. Marines compensate fairly well by stacking aircraft in close air support stacks or putting Marine aviation on alert lines for more responsiveness. Still an adequate approach, as seen in lessons learned across the decades remains satisfactory for the ground commanders. Hierarchical systems have the potential to bottleneck at the top and communication nets can be overwhelmed as seen during previous

Pacific campaign battles. The ability to decentralize this capability down even further such as the employment of an air support element can lessen the burden on the system. As seen during the Battle of Okinawa, difficult bottlenecks exist if everything goes back to the flagship or centralized node for final approval. A decentralized approach is necessary for high operational tempo environments. DASC processes and procedures adapted with the aid of technology, but routing procedures have not changed since WWII. The Naval forces require a streamlined approach to outpace multi-domain threats in the 21st century. The following approach offers some potential solutions.

Well-Synthesized Battle Knowledge. The success to a multi-domain environment is well-synthesized battle knowledge.[84] The DASC is largely a consumer and pusher of information. While synthesis occurs with senior leadership in the DASC, aided by available information from the FSCC, information is predominantly raw. Better synthesis between what happened, what is happening, and what is needed must evolve if there is a desire to employ future aviation assets to the best of their ability. Real time actionable intelligence from joint and strategic assets paired with verified targets from the ground units could bring the DASC into the 21st century. Recently fielded technology such as CAC2S Phase II and G/ATOR (ground and air variants) affords more than a human exchange of information. The opportunity exists for increased situational awareness with human/machine pairing. Developing a sensor network of ground, air, and maritime sensing has the power to speed up the exchange of actual information.

The future fight requires superior recon and intelligence.[85] "Effective fusion of reconnaissance, surveillance, and intelligence information is so important that it must receive the same emphasis as the delivery of firepower."[86] "Adversaries will routinely net together sensors, spies, UAS, and space imagery to form sophisticated 'ISR-strike systems' that are able to

[locate], track, target, and attack an opposing force."[87] The DASC must embrace the idea of information warfare as a seventh joint function. The core of naval integration relies on these two agencies and the emphasis on superior reconnaissance and intelligence must be integrated into these processes. Long-range weapons are only effective if informed. High levels of shared awareness among forces have shown to dramatically increase speed to scout, to decide, and to execute.[88] The Marine Corps must enable our core air and ground agencies the ability to provide actionable information to the right platform at the right time.

To truly enable air and ground integration, the DASC should embrace artificial intelligence capabilities. "A commander and his staff synthesize information, using decision support systems when they help to do the job better. Modern displays, geographic and alphanumeric displays, assist in the process. Artificial intelligence emulates the thinking process and (when it surpasses that process) automatically makes decisions. Allowing preplanning inputs such as priorities and appropriate targeting solutions helps automate decisions and provides a faster response time. Automating some of the actions in the DASC is the same idea as automated fire control systems. Right now, the air support system is burdened by building situational awareness from too many inputs. Speeding up this process with artificial intelligence could allow leaders to focus on key decisions.

The success of the Battle of Okinawa can lull the air support agencies into a false sense of comfort. The system designed over 75 years ago is relatively unchanged today despite advances in technology. The close integration between air and ground units stood the test of time hailing Marine Corps air support as the most effective service in close air support during WWII, Korea, Vietnam, and Iraq. While tactics in terminal control advanced significantly, air support control and air support processes remained relatively static. Without a significant

struggle, organizations tend to stay the same overtime. The Marine Corps should take the positive lessons from the Battle of Okinawa and continue to refine the DASC to keep pace with an advancing adversary.

Conclusion

There will always be secret weapons and wartime surprises.[89] For aviation command and control Marines their secret weapon in World War II was radar and air to ground communications. The Okinawa campaign provided the first large-scale opportunity for aviation Marines to demonstrate their conception of tactical aviation command and control and ground support. Having phased control ashore during the largest amphibious operation of the Pacific campaign, the Marines controlled all the airspace over Okinawa despite command phasing ashore on day 47 of the battle. The most notable innovations were the better integration of air-ground offensive units, more efficient radar gear and emphasis and responsibility for air-warning squadrons, and the quality of fighter direction.[90]

The organization and employment of blended Navy, Marine Corps, and Army staffs deemed critical to bring the full weight of the Joint force to bear against the Japanese. Integrated staffs with the ability to fight on or off ship were necessary to adapt to the ever-changing situation.[91] Land based command offered the flexibility and agility needed to synchronize all elements of the expeditionary force ashore and operate seamlessly across the littorals. Had an integrated staff of amphibious and carrier aviation existed, many of the parochial fights of Marine aviation predominantly supporting fleet defense while carrier aviation supported close air support might have been rectified. Delegating responsibilities to commanders on scene allowed actions to outpace vulnerabilities.

The lack of air superiority plagued the fleet slowing down the operational tempo.

Depending on the situation, maintaining command ashore despite achieving local air superiority is an option. Hanging on to command simply for the lack of air superiority is not a necessity as proven by the effectiveness of the ADCC ashore. A common integrated naval command and control system is needed to share situation awareness across all components of the naval force.[92] Interoperability across the maritime and Joint force is necessary to maintain tempo and reduce or create surprise. A common system enables integrated staffs and affords the opportunity for agile command and control organizations able to fight on and off ship without significant hindrance from weapon's systems. Maintaining a fluid environment enables agile organizations and reduces the battle management signature.

The air defense network and the enabling actions of the air defense command and air control squadrons allowed unified action across the entire expeditionary force. The Marine Corps air defense capabilities provided the Expeditionary Force Commander the ability to sense, detect, track, and target. The speed and agility of these units is the center point for land and maritime force protection and enabling actions. During the Battle of Okinawa, radar sensing allowed mobility and force protection of the fleet and land based units. Any failures directly resulted in neutralization or destruction of friendly ships.

Highlighted to Marines was the tension created between aviation and ground units over the necessity for air superiority and the desire for close air support aviation. It is highly likely the tension will exist across Marine aviation during times when air superiority is unlikely. Education of ground troops and flexibility by air support agencies is key to make this as seamless as possible. Marine aviation, while highly successful at maritime interdiction missions and vital to the success of the maritime fight in Okinawa viewed this role as more appropriate for carrier air. There is a balance between the asset desired and the asset required. This is where an

integrated staff with appropriate aviation representation across the Naval force can best look out for the naval organization as a whole.

The air support system employed in 1945 despite names changes largely reflect the same air support procedures developed and refined in WWII. Hierarchical systems have the potential to bottleneck at the top and overwhelm communication nets. The naval forces require a streamlined approach to outpace multi-domain threats in the 21st century. The success to a multi-domain environment is well-synthesized battle knowledge.[93] The opportunity exists for increased situational awareness with human/machine pairing. Developing a sensor network of ground, air, and maritime sensing has the power to speed up the exchange of actual information. The future fight requires superior recon and intelligence.[94] "Effective fusion of reconnaissance, surveillance, and intelligence information is so important that it must receive the same emphasis as the delivery of firepower."[95] The Marine Corps must enable our core air and ground agencies the ability to provide actionable information to the right platform at the right time. Right now the system is burdened by building situational awareness from too many inputs. Speeding up this process with artificial intelligence could allow leaders to focus on key decisions.

In *Fleet Tactics*, Wayne Hughes discusses the importance behind affecting great transitions. For the MACCS, the time is now. Aviation Marines are on the cusp of a new technological era. The strength of the naval fleet may indeed be shore-based with CAC2S, CTN, G/ATOR, and Joint Strike Fighter bringing together well-synthesized battle knowledge and unleashing the total firepower of the naval fleet. To fully embrace technology, tactics, techniques, and organizations must be exercised and fully developed. Embrace the opportunities and be part of those affecting a great transition.

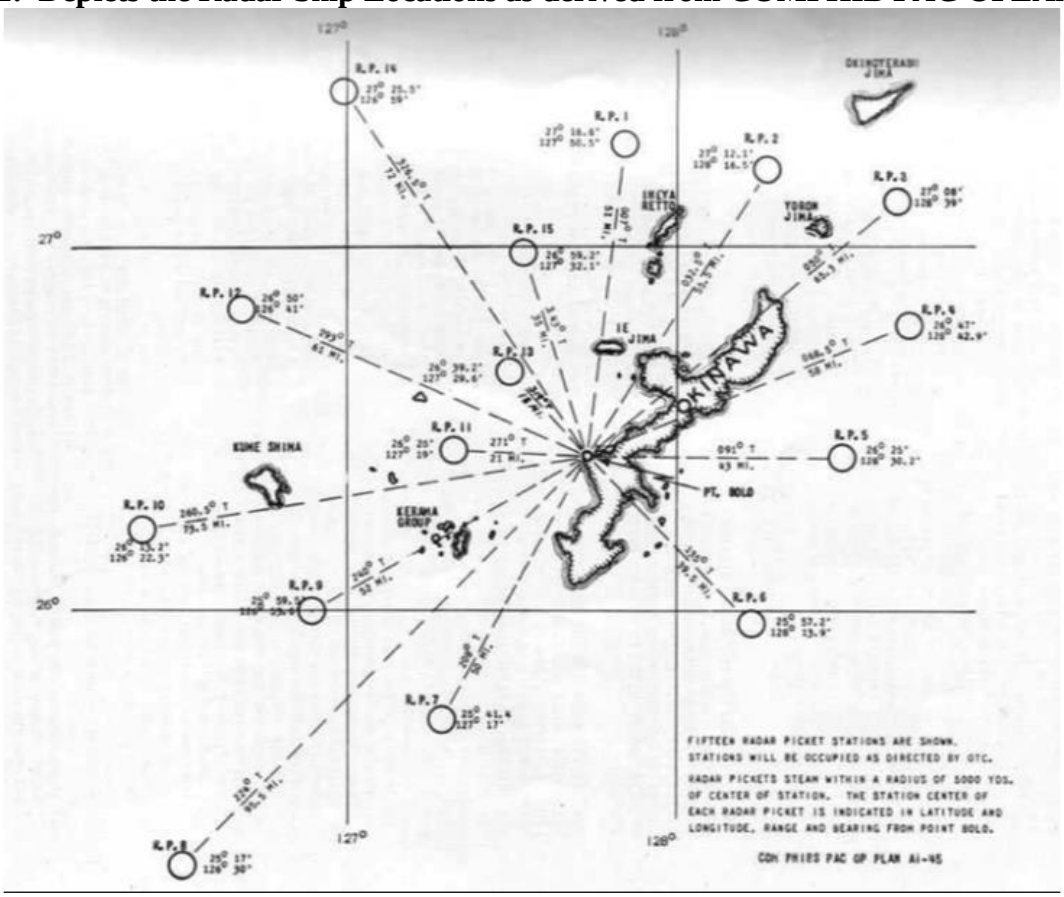
> As for great transitions in naval warfare, these take longer than expected, not only because of the time required to perfect a new instrument of war and build it in

> numbers, but also because a shakeout of tactics takes time. While the new manner of warfare shapes up, plans must be formulated for a transition, during which the old and the new both have combat roles to play. These roles are decided by evolutionary tactics, doctrine, and training-that is to say by warrior-customers. But the ultimate impact of a great transition in the hands of a master tactician may be felt like a bolt from the blue, even when technology has introduced the new weapons in front of our very eyes. Great transitions require the engineering insight to fuse several scientific potentialities into a dramatically different weapon or sensor, the tactical insight to see how the weapon will change the face of battle, and the executive leadership to pluck the flower of opportunity from the thorns of the government. The inspiration for these transitions often comes from outside the Navy. The perspiration always comes from within it.[96]

The naval and Marine Corps aviation command and control communities must reflect on the lessons learned from the Battle of Okinawa in order to drive down the future risks associated with fighting a peer or near-competitor in the littorals. Reflecting on the tactical successes and failures allows the naval force as a whole the opportunity to posture itself accordingly to meet the demands outlined in naval and Marine Corps future operating concepts for 2025.

APPENDIX A

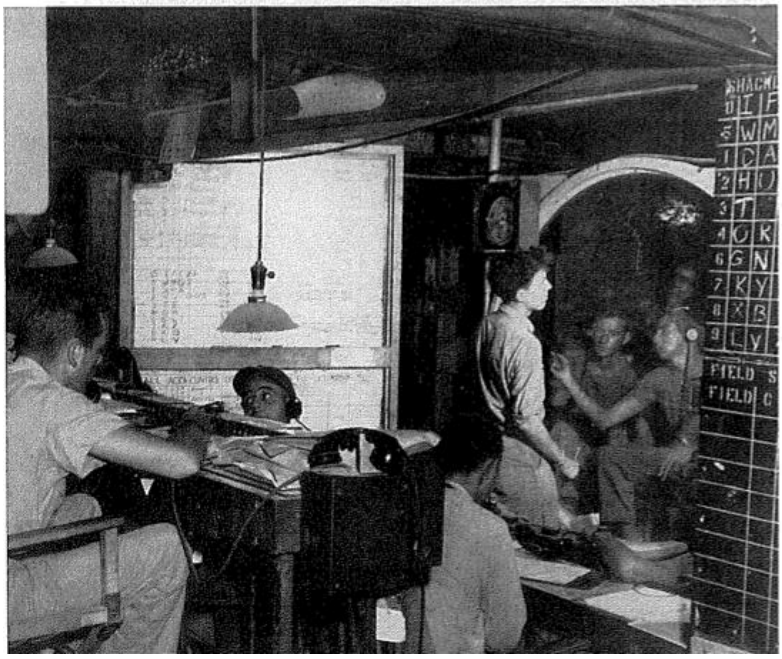
Photo 1: Depicts the Radar Ship Locations as derived from COMPHIB PAC OPLAN.[97]



Source COMPHIB PAC OPLAN 01-45

Photo 2: Operating Positions in Main ADCC.

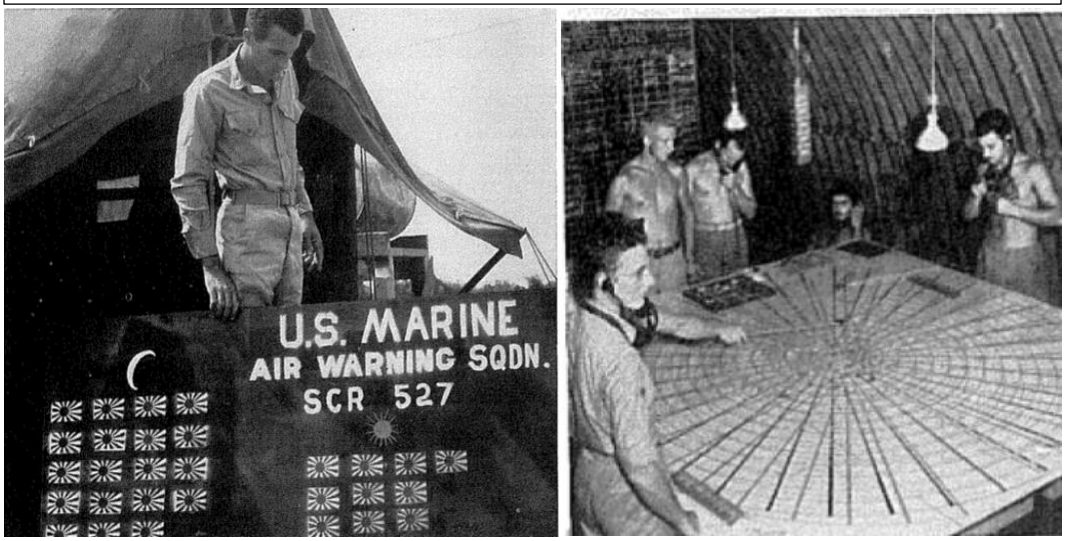
Operating positions in main ADCC were: 1st row—VHF, intercept fighter director, radar telling; 2nd row—AAA liaison, fighter director watch officer, VHF position; back row—air/sea rescue people and one Army bomber liaison officer. Below, men behind vertical plotting board made plots, man in front drew course of aircraft



Source: Radar Magazine, Number 11, 10 September 1945.[98]

Photo 3,4: Operating Positions in Main ADCC.

Left photo: Chief controller eyes record of 19 night, 10 day kills by this Marine SCR-527 on Ie Shima. Right photo: Control center of Marine AWS. One received report from neighboring islands.



Source: Radar Magazine, Number 11, 10 September 1945.[99]

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[1] Robert Sherrod, *History of Marine Corps Aviation in World War II* (The Association of the United States Army: John D. Lucas Printing, 1952), 369-370. Citations refer to the Nautical & Aviation Publishing edition.
[2] Robert Sherrod, *History of Marine Corps Aviation in World War II* (The Association of the United States Army: John D. Lucas Printing, 1952), 369-370. Citations refer to the Nautical & Aviation Publishing edition.
[3] John A. De Chant, *Devilbirds: The Story of United States Marine Corps Aviation in World War II* (Harper & Brothers Publishing: New York and London, 1947), 244.
[4] Roy E. Appleman, James M. Burns, Russell A. Gugeler, and John Stevens. *United States Army in World War II, The War in the Pacific, Okinawa: The Last Battle*. 50th Anniversary Commemorative Edition (Washington, DC: Center of Military History United States Army, 1993), 23.
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[6] De Chant, *Devilbirds*, 241-243.
[7] De Chant, *Devilbirds*, 241-243.
[8] *Close Air Support in the War Against Japan*, February 1955, USAF Historical Division, Research Studies Institute, Air University, 213.
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[10] 10th Army Tentative Operations Plan 1-45, 1945, World War II Okinawa [Folder 1, Box 12] COLL 3720, Archives and Special Collections Branch, Marine Corps University, Quantico VA.
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[13] De Chant, *Devilbirds*, 224.
[14] Tenth Army After Action Report, Apr 1945-Jun 1945 [Box 13].
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[17] Tactical Air Force Operations Plan No. 1-45, [Box 15].
[18] Sherrod, *History of Marine Corps Aviation in World War II*, 370.
[19] Tactical Air Force Operations Plan No. 1-45, [Box 15].
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[21] Sherrod, *History of Marine Corps Aviation in World War II*, 372-374.
[22] Tactical Air Force Operations Plan No. 1-45, Air Defense Command, [Box 15].
[23] Sherrod, *History of Marine Corps Aviation in World War II*, 377-378.
[24] Sherrod, *History of Marine Corps Aviation in World War II*, 379.
[25] Sherrod, *History of Marine Corps Aviation in World War II*, 379.
[26] Office of the Chief of Naval Operations, "The Number One Lesson of Okinawa" *CIC: Combat Information Center* 2, no.8 (August 1945): 16-17.
[27] Office of the Chief of Naval Operations, "The Number One Lesson of Okinawa" *CIC: Combat Information Center* 2, no.8 (August 1945): 16-17.
[28] Sherrod, *History of Marine Corps Aviation in World War II*, 225.
[29] Headquarters, US Marine Corps, Marine Air Intelligence Bulletin, Prepared by Intelligence Section Division of Aviation June 1945, Washington, DC. Referred to as Intelligence Bulletin June 1945 from here forward.

[30] Office of the Chief of Naval Operations, "The Number One Lesson of Okinawa" *CIC: Combat Information Center* 2, no.8 (August 1945): 16.
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