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THE EVOLUTION OF FIGHTER DIRECTION DOCTRINE AND ITS IMPACT ON WORLD WAR II IN THE PACIFIC

An Essay

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In Partial Fulfillment

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Graduate Certificate in Maritime History

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by
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THE EVOLUTION OF FIGHTER DIRECTION DOCTRINE
AND ITS IMPACT ON WORLD WAR II IN THE PACIFIC

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ABSTRACT

The evolution of fighter direction doctrine and the implementation of emergent technologies that greatly enhanced the fleet's protection significantly impacted the success of the US Navy during World War II in the Pacific. Over the past seventy-five years, naval historians have tended to gloss over the critical development of fighter direction. However, protecting the fleet was a significant concern throughout the war, and the role fighter direction played in providing that protection was crucial. This paper traces the evolution of fighter direction doctrine and application of emergent technologies from the interwar period until decisive victory was achieved in World War II in the Pacific. The US Navy's ability to develop a learning organization that quickly synthesized lessons learned from battle experience and apply innovative change in fighter direction ensured the organization's success.

INTRODUCTION

Over the past seventy-five years, naval historians have provided in-depth accounts of fleet and fighter action in the Pacific and discussed the evolution of technology, tactics, and doctrine throughout the war. At the same time, they tend to gloss over the critical development of fighter direction, leaving it to the complaints and animosity harbored towards it during the after-action reports of battles throughout the war. However, protecting the fleet was a significant concern throughout the war, and the role fighter direction played in providing that protection was crucial. It does not receive the attention it deserves.

The evolution of fighter direction doctrine and the implementation of emergent technologies that greatly enhanced the fleet's protection significantly impacted the success of the US Navy during World War II in the Pacific. The first section of this paper examines what doctrine is and is not and why there was a lack of focus on fighter direction during the interwar era, as encapsulated by *USF 74: Current Tactical Orders and Doctrine,* released in March 1941. Next, the hard-fought battles, lessons learned, and innovative measures fighter directors took through Guadalcanal to improve the fleet's protection will be analyzed. The third section examines the innovation caused by the release of *Current Tactical Orders and Doctrine US Pacific Fleet (PAC-10)* and its successor *Current Tactical Orders and Doctrine US Fleet (USF-10A).* The release of these documents would lead to the creation of the interchangeable fast carrier task forces of Task Force 58 and 38, facilitating the rapid integration, improvement, and regulation of fighter direction across the fleet leading to victory in the Pacific. Finally, aircraft carrier action in the Pacific after the release of these documents and the successful transformation of fighter direction that ensured the protection of the vast carrier task forces will be discussed. The US Navy was able to synthesize elements of interwar doctrine with the lessons

learned throughout the war and develop new doctrine that enabled victory. In the realm of fighter direction, the ability to learn from failures and realize the fighter requirement to protect the vulnerable carriers alongside the successful implementation of new technologies played an integral part in that success.

DOCTRINE

Throughout the history of warfare, military leaders and organizations have struggled to develop the tactics, techniques, and procedures expressed through doctrine in a timely manner to keep pace with emergent technologies. While the definition of doctrine varies, in military operations, it boils down to the game plan a military expects its forces to follow during combat operations that will lead to success in warfare.[1] It is a set of implicit and explicit assumptions that govern action and guide decisions without dictating exact instructions.[2] Doctrine prescribes tactics or methods across the commander's formation, allowing them to concentrate on directing the battle without micromanaging echelons below him, allowing for easier coordination across the force when direct communication is not available. Therefore, military organizations need to see doctrine as a means, not extremely important in itself, to a great end; victory in battle and war. To be successful, organizations must allow flexibility, experimentation, and innovation in implementing tactics and techniques, viewing doctrine as guidelines rather than rules.[3]

Fortunately for the US Navy, the organization was very open to experimentation and innovation throughout the interwar era and World War II. The US Navy was able to develop flexible doctrine that facilitated a rapid learning process alongside the introduction of emergent

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[1] Michael Elliot Kern, "Striking Eagles: Doctrine, Training, and Fighting Squadron Five at War in the Pacific" (master's thesis, The George Washington University, 2011), 37.
[2] Trent Hone, *Learning War: The Evolution of Fighting Doctrine in the US Navy, 1898-1945* (Annapolis, Maryland: Naval Institute Press, 2018), 11.
[3] Kern, "Striking Eagles," 37, 38.

technologies. Viewing doctrine as guidelines, the US Navy and its emerging emphasis on airpower allowed it to integrate new technologies and execute a rapid evolution in doctrine that ensured success against the Imperial Japanese Navy (IJN). While the culture of the Japanese Navy inhibited its ability to develop systems and measures to deal with the innovations occurring in the Pacific, an innovative mindset permeated the US Navy. The ability of the US Navy to adapt and synthesize interwar doctrinal concepts, take a new approach to tactical doctrine, and introduce the fast carrier task force through new tactical manuals and fleet organization along with new battle plans enabled an overwhelming defeat of the IJN.[4]

INTERWAR FIGHTER DIRECTION DOCTRINE AND EXECUTION

During the interwar era, fighter direction doctrine and execution were in their infancy and severely under-developed for many reasons. First, during this time, the Navy still considered the battleship as the backbone of the Navy and maintained much of its focus on developing and executing battleship-centric fleet doctrine.[5] Second, it seemed an effective offense was the only viable defense of carriers because interwar exercises proved that the aircraft carriers were highly vulnerable to surface and air attacks and that antiaircraft gunnery could not provide reasonable security against air attacks as late as 1940.[6] Third, the US Navy simply did not have enough aircraft carriers to test emerging doctrine due to the limitations of the Washington Naval Treaty. Fourth, the fighter direction doctrine and execution that evolved during World War II relied heavily on emergent technologies that were either still non-existent or were difficult to test in the interwar games and exercises that facilitated the development of doctrine at the time. For these reasons, the US Navy would enter World War II with *USF 74,* which discusses different patrols

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[4] Trent Hone, "US Navy Surface Battle Doctrine and Victory in the Pacific," *Naval War College Review* 62, no. 1 (2009), 68.
[5] Jack Greene, *War at Sea: Pearl Harbor to Midway* (New York: Gallery Books, 1988), 20.
[6] *Defense of Ships Against Aircraft*, File Series 420-11, Folder 1940-1941, RG80, National Archives, 2.

to protect the fleet but does not once mention fighter direction, illuminating the immature development of fighter direction on the eve of World War II.

During the interwar period, US naval doctrine and thought remained tied to the ideas of Alfred T. Mahan and the dominating role of the battleship as the backbone of the fleet in attaining control of the sea. Throughout the 1930s, most naval commanders doubted aircraft could do any severe damage to an enemy battle force and viewed the aircraft carrier and its airplanes as an auxiliary tool used to locate the Japanese fleet and help secure air superiority so that the battleship could win the battle.[7] Exercises during this period showed that carriers were highly vulnerable to surface ship attacks due to the short distances aircraft of the time could fly, which would necessitate getting too close to the enemy fleet and causing the engagement and destruction of the carrier by surface warships.[8]

The battleship proponents of the US Navy, the 'Gun Club,' prepared itself for another Battle of Jutland in 1916 as seen in the development of War Plan ORANGE, the American plan developed for war against Japan. War Plan ORANGE proposed that the army would defend the Philippines against Japanese invasion. At the same time, offensive naval action occurred against the Japanese Navy, finding the fleet, and defeating it in a classic, short, and decisive fleet action between battleships, the pre-eminent tool of victory.[9] A focus on the battleship permeated naval thought during the interwar period. By December 1941, the US Navy had twelve battleships but only six operational fast "fleet" carriers and the General Board only planned to procure four more carriers across the rest of the decade.[10]

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[7] Kern, "Striking Eagles," 44.
[8] Mark Allen Campbell, "The Influence of Air Power Upon the Evolution of Battle Doctrine in the US Navy, 1922-1941" (master's thesis, University of Massachusetts at Boston, 1992), 161.
[9] Kern, "Striking Eagles," 38, 39.
[10] Campbell, "The Influence of Air Power," 5, 8.

At the same time, the exercises of the interwar period proved time and again that the aircraft carriers were a high priority target that was difficult to defend, and the US Navy was unable to develop a tenable solution to the problem. During the interwar period, the US Navy synthesized the lessons learned from the real-world Fleet Problem exercises and the war game exercises developed by Rear Admiral William Sims at the Naval War College. War game exercises included strategic "chart maneuvers," exploring the issues of war with Japan, and tactical "board maneuvers," exploring the value of different offensive and defensive tactical formations and force mixes.[11]

While these exercises were unable to develop the solutions of how to defend best and integrate the carriers with their emergent technologies not yet available, they did facilitate several tentative conclusions that would enable carrier doctrine for the US Navy entering World War II. First, due to the limited defense capabilities of carriers and their ability to deliver "pulses" of power, it was essential to get the first strike against an enemy. Exercises showed the necessity of targeting carriers first to gain air superiority. The measure of effectiveness of carrier strike was the number of aircraft in the air and the ordnance it could deliver.[12] Many believed carriers under concentrated air attacks were almost impossible to defend at this time. Second, it was crucial to conduct effective scouting to be the first to find and destroy the enemy's carriers.[13]

With the introduction of the *Saratoga* and *Lexington*, the number of carrier-launched aircraft increased from 30 aboard the *Langley* to a total of 180 aircraft. However, the wargames of the interwar period were of limited use in testing the impact of new technologies, including the introduction of fighters that could provide defense in addition to antiaircraft gunnery against

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[11] Jan M. Van Tol, "Military Innovation and Carrier Aviation-The Relevant History," *Joint Forces Quarterly*, (Summer, 1997), 80.
[12] Ibid, 80.
[13] Hone, "Replacing Battleships with Aircraft Carriers in the Pacific in World War II," 57.

enemy aircraft attacks on carriers. The adjudication of exercises relied on accurate data to produce accurate results, which the Navy simply could not predict and replicate without wartime experience.[14] An example from Fleet Problem IX shows that the *Saratoga* was sunk three times in one day by the adjudicating umpire by surface ships, submarines, and attacking aircraft. Exercises seemed to support the idea that carrier activity would be brief and exciting, setting the stage for the surface battle. At the same time, the exercises confirmed the viability of the carrier task-force concept, but there was a need for many more in the fleet.[15]

While the US Navy had six operational carriers by December 1941, it relied heavily on two carriers throughout most of the interwar period to conduct exercises and develop doctrine. Two carriers were not enough to fully understand the carriers' crucial role and emerging technologies that would so profoundly impact World War II. While the discussion regarding whether or not the limitations of the Washington Treaty helped or hindered aircraft carrier development during this period is outside the scope of this paper, the fact remains that the *Lexington* and *Saratoga* were the only two "fleet" carriers to participate extensively in the US Navy's Fleet Problems and help develop doctrine during the interwar period.[16]

The limited availability of carriers during the interwar period exercises caused numerous problems in the doctrine developed during the interwar period that would need to be remedied by lessons learned through wartime experiences. First, the Navy was unable to appreciate the growing effect of airpower on naval engagements because the Fleet Problems showed time and again the vulnerability of carriers but was unable to replicate the overwhelming force and impact

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[14] Campbell, "The Influence of Air Power," 15, 56, 68.
[15] James H. Belote and William M. Belote, *Titans of the Seas: The Development and Operations of Japanese and American Carrier Task Forces during World War II*, (New York: Harper and Row, 1975), 20.
[16] Campbell, "The Influence of Air Power," 141.

of concentrated air power. [17] Second, with only two large carriers to experiment with during the Fleet Problems, the US Navy regularly placed them on opposing sides or operated them in independent task groups, missing out on opportunities to coordinate multiple carriers within a task force, which we will see was crucial to success in the Pacific.[18] While Captain Richmond K. Turner stated in 1937, "The chief strategic function of the fleet is the creation of situations that will bring about decisive battle, and under conditions that will ensure the defeat of the enemy. We should, as with other means of action, be sure to employ a concentration of enough airplanes to produce the desired effect," there were simply not enough carriers or aircraft during the interwar period to determine how to best maneuver and employ groups to concentrate force.[19]

The fighter direction doctrine that would emerge during this time would therefore be a minimal set of guidelines to be built upon during the war due to emergent technologies that were difficult to test and practice during the interwar period. Throughout much of the interwar period, doctrinal procedures to protect and defend carriers relied heavily on keeping carriers hidden and dispersed.[20] In the air, the carriers utilized a highly ineffective and time-consuming Combat Air Patrol (CAP) process that used airborne fighter lookout patrols to detect the enemy's approach in given sectors, warn the task force, and do their best to make an interception and defend the fleet.[21] The primary tasks and concerns of the carriers and their aircraft were strike and reconnaissance. Scouts and torpedo bombers dominated carrier air groups to maximize the carrier's striking power.[22]

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[17] Ibid, 142, 180.
[18] Hone, "US Navy Surface Battle Doctrine and Victory in the Pacific," 73.
[19] Thomas C. Hone, "Replacing Battleships with Aircraft Carriers in the Pacific in World War II," *Naval War College Review* 66, no. 1 (2013), 56-57.
[20] Hone, "US Navy Surface Battle Doctrine and Victory in the Pacific," 73.
[21] John B. Lundstrom, *The First Team: Pacific Naval Air Combat from Pearl Harbor to Midway*, (Annapolis, Maryland: Naval Institute Press, 1984), 89-90.
[22] Hone, *Learning War: The Evolution of Fighting Doctrine in the US Navy, 1898-1945*, 255.

It was not until 1940, with the introduction of faster and bigger monoplanes and the installation of CXAM radars aboard carriers, that emergent technologies would significantly improve the fleet's protection and decrease the carrier's vulnerability.[23] CXAM Radar, and its improved replacement CXAM-1 installed in 1941, allowed an operator to identify approaching aircraft within an 80-mile radius, essentially a line of sight radar but still better than the naked eye, but it was difficult for operators to determine the number and altitude of contacts.[24] Built by the Radio Corporation of America, the CXAM radar would evolve into the 'flying bedspring' SK radar used by the US Navy throughout World War II.[25] The Fighter Direction Officer (FDO) would identify threats in Radar Plot, then choose from the fighter elements who would intercept the incoming threat based on the threat location. According to Lieutenant Commander Jimmy Thach, the FDO could "win or lose the battle right there," based on the timeliness of the decision and at what elevations the FDO had stationed his CAP fighters.[26] With the late entry of these crucial technologies that would facilitate fighter direction throughout the war, it is no wonder that there was little testing and lessons learned from the interwar period regarding fighter direction as the United States went to war in 1941.

However, US FDOs would have a leg up on executing their duties upon entering World War II due to friendly relations with Great Britain and the exchange of ideas and technologies due to the Tizard Mission in September 1940. As the head of the British Aeronautical Research Committee, Henry Tizard's team had propelled the development of radar in Great Britain, which proved critical to the country's defense during the Battle of Britain. Foreseeing a long war in

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[23] Campbell, "The Influence of Air Power," 180; Craig L. Symonds, *The Battle of Midway: Battle of Midway,* (New York: Oxford University Press, 2011), 78.
[24] Lundstrom, *The First Team: Pacific Naval Air Combat from Pearl Harbor to Midway*, 90.
[25] Louis Brown, *A Radar History of World War II: Technical and Military Imperatives,* (Bristol, England: Institute of Physics, 1999), 67.
[26] Jimmy Thach, LCDR, US Navy, quoted in Lundstrom, *The First Team: Pacific Naval Air Combat from Pearl Harbor to Midway*, 90.

which Great Britain's production capacities would be insufficient, Tizard was able to get government support for a mission to exchange British scientific and technical material secrets with the United States in exchange for assistance in labor and facilities to maintain their war effort.

While the US Navy maintained RCA's radar for enemy detection, the conversation was highly beneficial to developing US fighter direction methods in two aspects. First, the US agreed to use the British Mark II transponder system for Identification Friend or Foe (IFF), which would enhance an FDOs ability to track friendly aircraft once enough were installed and utilized by friendly aircraft. Prior to the installation of IFF transponders, FDOs had to rely on the recognition of friendly voices on the radio and call out enemy forces that were able to break into the highly insecure radios at the beginning of the war. Secondly, an indirect but just as important result of the Tizard Mission was that the US began sending servicemembers to Great Britain for preliminary training on radar.[27] The training received in Great Britain was indispensable to the US military, and the lessons learned in Great Britain would facilitate the development of numerous fighter direction schools in the US, starting with the opening of schools in Norfolk, Virginia, and San Diego, California in August, and September 1941.

Months before the attack on Pearl Harbor, the US Navy released *USF 74: Current Tactical Orders and Doctrine* in March 1941. With a focus on air operations, *USF 74* discussed different air patrols to protect the fleet, but it does not mention fighter direction once. Fighter direction would need to be improvised by FDOs, executed, and rapidly learned and disseminated across the fleet to ensure proper techniques were captured and utilized. With a rapid influx of emergent technologies alongside a young and changing force structure in naval aviation, *USF 74*

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[27] Brown, *A Radar History of World War II: Technical and Military Imperatives,* 131, 159, 160, 163.

set up guidelines rather than rules for aviation formations to foster innovation. The document states, "as types, modes and missions vary so widely, distances, intervals and heights…for formations are not specified, nor are there prescribed formations for any particular purpose."

USF 74 established five different aircraft patrols to warn of the incoming air, surface, and subsurface threats to allow time to employ countermeasures, destroy attacking enemy forces, and detect, report, and, if possible, destroy sea mines. Of particular concern to the development of fighter direction, carriers would have to rely on the eighteen fighter aircraft assigned to the air wing to execute the outer air patrol in coordination with the Aerial Pickets, a small element of forward airborne reconnaissance and early warning, and Combat Air Patrol to detect, report, and destroy enemy scouting or approaching attack aircraft at a range of 25 miles beyond the outer surface screen. The doctrine dictated that the CAP would employ a concentration of at least six planes to deny enemy air attacks at an altitude between twelve and twenty thousand feet, with the possibility of retaining the entire fighter squadron, instead of escorting offensive strike assets, to execute CAP duties if the commander anticipated enemy bombing attacks. Additionally, *USF 74* prescribed deploying a three to four-plane section with altitudes between seven and ten thousand feet to identify enemy scouting and observation aircraft. *USF 74* highlighted that the CAP would be the duty most often executed by the fighter squadrons and its most important as a part of the antiaircraft defense of the fleet. It recommended stationing the CAP at an altitude above the expected approach of enemy bombers, concentrating if quantitatively inferior to the expected attack, and dispersing into two or more groups if quantitatively superior to the expected attack. However, *USF 74* recommended avoiding the detachment of individual units or sections to attack enemy aircraft for concern that it may be a decoy for a more powerful attack.

Additionally, *USF 74* dictated that "protective aircraft should regain station immediately (when) an attack is withdrawn…since this separation from the protected area or formation leaves it exposed to further attack." In the under-developed realm of radio security, *USF 74* promulgated the rule that "If possible, avoid radio transmission." On the other hand, in cases where speed outweighed security, such as contact with enemy aircraft, radio contact could be used freely. The doctrine allowed for "the omission of formal calls…in voice transmissions…relying for authentication upon the recognition of voices of pilots or special, easily memorized code words." Another concern promulgated in *USF 74* was identifying friendly aircraft. The doctrine called for aircraft to remain outside the sight of antiaircraft weapons range as much as possible and to use specific approaches and recognition signals when approaching friendly forces. Identification of aircraft was another early concern that would be crucial to fighter direction. The emergent technology of Identification Friend or Foe (IFF) would assist in avoiding and decreasing the number of friendly fire incidents. Finally, essential to the success of the fighter squadrons, *USF 74* dictated that fighter squadrons receive a proper and thorough indoctrination of tactical rules and procedures utilized by the carriers they arrived at because of the numerous and complex tactical situations pilots would confront.[28]

USF 74's lack of fighter direction instruction shows that during the interwar period, there was insufficient experience in fighter direction and the emergent technologies that would facilitate its execution to develop effective tactics and doctrine. While the US Navy lacked the materiel and emerging technologies that would lead to success during World War II in the Pacific, it fostered an innovative learning organization that facilitated a rapid learning cycle and *USF 74* established a foundation of guidelines that would enable fighter direction. However,

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[28] W. F. Halsey, VADM US Navy, Commander Aircraft Battle Force, *USF 74: Current Tactical Orders and Doctrine U.S. Fleet Aircraft Volume One Carrier Aircraft,* March 1941, 1, 60, 62, 66, 69, 75, 106 120, 121.

wartime experience was necessary to transform the US Navy's approach to warfare and bolster fighter direction execution. Those experiences and advancements in technology would enable a revolution in fighter direction that would allow carriers to operate more effectively, pooling their resources together for defensive support and offensive capabilities. The ability of the US Navy to integrate the lessons learned during the interwar period with the experiences of war while also harnessing emergent technologies facilitated the development of task forces built around multiple carriers and turned the tide in World War II in the Pacific. Next, this paper will turn to the hard-fought battles and lessons learned throughout the first battles of the Pacific that would facilitate that transformation.

WAR IN THE PACIFIC THROUGH MIDWAY

During the seven months following the attack on Pearl Harbor, the IJN's momentum would facilitate the seizure of positions south from the Aleutians to Singapore to develop a robust defensive perimeter before the battles of Coral Sea, and Midway would swing the momentum of the war. In May of 1942, the first carrier battle in history occurred in the Coral Sea. The Japanese carriers *Shokaku*, *Zuikaku*, and the light carrier *Shoho* ran into the awaiting US carriers, *Yorktown* and *Lexington*. Due to intelligence intercepts, Admiral Chester W. Nimitz was able to intercept Operation MO, the Japanese plan to take Port Moseby and solidify their defensive perimeter before the industrial power of the United States flooded the Pacific with overwhelming firepower in the form of large numbers of carriers and airplanes.[29]

Aboard the *Lexington*, FDO Lieutenant Frank "Red" Gill provided fighter direction for the defense of the US carriers. Gill relied on radar to identify incoming "snoopers," enemy reconnaissance planes, and "bogies," unidentified aircraft, and utilized the "direct method" of

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[29] Symonds, *The Battle of Midway*, 109, 153.

fighter direction calculating the point of contact himself, relying on the minimal standardized vocabulary to provide the estimated range, bearing, and altitude based on the CXAM-1 radar plot, instead of just providing an estimated range, bearing, and altitude to the lead pilot and letting him take control of the situation. Despite heavy cloud cover, which affected the radar and hindered visual contact by fighters trying to intercept incoming enemy aircraft, Gill was able to pick up the incoming attack at 80 miles but wasted four minutes waiting to see what developed. Gill finally decided to execute a piecemeal CAP, sending nine fighters to intercept the attack between 15 and 20 miles out but only put three at 10,000 feet and six at 1,000 feet because he was concerned about low-level torpedo attacks. The remaining eight fighters remained over the ships as a second line of defense in addition to antiaircraft fire and evasive surface maneuvers to try and dodge the attacks.[30]

The lack of experience, rudimentary on-the-job training occurring early in the war, and weak fighter direction led to the decisions to execute a disintegrated CAP at altitude and keep fighters in reserve, which were both extremely detrimental to the fleet's protection. At the Battle of Coral Sea, the US lost the *Lexington* to two bombs and two torpedoes, a fleet oiler, a destroyer, and damage to *Yorktown*. However, it was a strategic victory for the US, with the Japanese losing the small carrier *Shoho*, significant damage to *Shokaku*, and large losses in Japanese pilots. IJN losses would keep both *Shokaku* and *Zuikaku* out of the Battle of Midway and forced the IJN to postpone plans for the invasion of Port Moresby until later in the summer.[31]

In the aftermath of Coral Sea, animosity surrounding the loss of the *Lexington* focused on what Lieutenant Commander C.C. Ray summed up as "Many of us are positive that the loss of

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[30] Lundstrom, *The First Team: Pacific Naval Air Combat from Pearl Harbor to Midway*, 91, 192, 246, 251.
[31] Symonds, *The Battle of Midway*, 170, 174, 175; Lundstrom, *The First Team: Pacific Naval Air Combat from Pearl Harbor to Midway*, 285.

the *Lexington* was due, specifically and exactly, to the lack of fighter direction…he had to send out his fighters to intercept at or above the altitude of attack."[32] Gill's deployment of two lines and a reserve was beyond his training and equipment's ability to keep track of numerous contacts. Tactically, Lieutenant Commander Jimmy Thach, commander of VF-3, criticized the decisions that brought the CAP too far away from the defense of the ships in trying to track down the first wave of attackers. Others stressed that the CAP should vector as soon as possible to make an intercept at least 30 miles away from the ships. Intercepting further away from the ships would allow fighters to fight the incoming attack all the way back to the ships. Additionally, the fighting led to numerous recommendations to increase fighter strength from 18 to 27 and 50% spare pilots to bolster fighter strength. Technically, a lack of IFF gear aboard *Yorktown* aircraft hindered fighter direction by cluttering the radar screen and unnecessarily caused the FDO to investigate multiple friendly bogies.[33] The Navy's ability to capture these shortcomings and push out the lessons learned across the fleet via after-action reports and Fleet Bulletins would prove critical to rapid adaptation in the short term and the realization that doctrine needed to be updated to facilitate operations further.

It would take time for the lessons learned at the Coral Sea to circulate and be synthesized by the US Navy into better practices, but further intercepts of Japanese messages alerted the US of an impending attack on the island of Midway in the beginning of May 1942. Utilizing his three carriers, *Yorktown*, *Hornet*, and *Enterprise,* plus the airstrip on Midway, Nimitz concluded the US had parity with the attacking Japanese forces aboard the *Akagi*, *Kaga*, *Soryu*, and *Hiryu*, plus the element of surprise. US forces allowed the Japanese attack to bear down on Midway,

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[32] *Lieutenant Commander C.C. Ray Interview, 19-20 August 1942,* Record Group 313, Entry P10436, COMNAVEU General Administrative Files, 1939-1944, Box 18, 3.
[33] Lundstrom, *The First Team: Pacific Naval Air Combat from Pearl Harbor to Midway*, 108, 116, 304.

and while their aircraft were busy with that launched a counterattack from the carriers that would destroy three of the four Japanese carriers in just over five minutes. However, the Japanese responded with their own attack on the American carriers.

While US Navy doctrine stated that air squadrons from each carrier would cooperate in defense of the carriers, there was no established doctrine about how planes from multiple carriers would operate together in an integrated formation the way the IJN exercised and employed.[34] It was still a matter of debate whether it was more beneficial to keep two or three carriers within a five-mile radius for mutual fighter protection or to separate by 60-70 miles to avoid detection of all the carriers simultaneously.[35] At Midway, this would lead to the *Enterprise* and *Hornet* being nearly 40 miles away from *Yorktown* when she came under attack and needed assistance.[36] Aboard the *Enterprise*, fighter director Commander "Ham" Dow was able to integrate the fighters of the *Hornet* into a high CAP at 18,000 feet and the fighters of *Enterprise* in a low CAP. However, he caused great confusion when he used the term "arrow" instead of "vector," meaning to proceed on a true rather than magnetic course, especially since he meant vector when he sent fighters off to investigate a snooper.[37] At approximately 1359 that afternoon, Air Group Commander and fighter director aboard *Yorktown*, Lieutenant Commander Oscar Pederson, identified an incoming Japanese attack at about 46 miles out and vectored his CAP to intercept, which they did at roughly 15-20 miles away. While the CAP "splashed" several Japanese aircraft, seven bombers made it through. They dropped three bombs on *Yorktown*, followed by a

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[34] Symonds, *The Battle of Midway*, 184, 245.
[35] *Interview of Commander L.J. Dow, USN, Communications Officer, Admiral Halsey's Staff in the Bureau of Aeronautics 1942*, 4.
[36] Symonds, *The Battle of Midway*, 315.
[37] Lundstrom, *The First Team: Pacific Naval Air Combat from Pearl Harbor to Midway*, 334, 338; *Ray Interview*, 4.

second attack disrupted by the CAP. While she could have been salvaged following the aerial attack, a follow-on submarine attack put two torpedoes into *Yorktown* and sunk her.[38]

Looking back at the action at Midway, the US Navy saw that fighter direction, and the execution of the CAP performed better than it had at the Coral Sea and took away some correct and incorrect lessons learned. One false lesson learned, was that since Task Force (TF) 16 of *Enterprise* and *Hornet* had escaped the action unscathed, some US admirals believed that separate carrier task forces operating over the horizon from one another was the key to combat effectiveness when in actuality it fragmented the CAP and ability to defend the carriers.[39] Spruance's report that the action showed "the advantages of operating at least two carriers together were manifest" went unheard for the time being.[40] The decision to execute dispersed carrier operations would lead to more disappointment at Guadalcanal before rectification through the creation of multicarrier task forces.

Tactically, consternation surrounded the FDOs' inability to concentrate fighters at the point of intercept and at what altitude to place fighters. Following Midway, Nimitz decided to increase fighter squadron strength from 18 to 24 and then again within a few weeks up to 36 aircraft would help rectify the problem somewhat, but issues would remain.[41] The additional fighters would allow FDOs to "stack" the CAP in layers with a high guard against dive bombers and a lower guard against torpedo aircraft and snooper reconnaissance aircraft.[42] Additionally, frustration circulated surrounding Ham Dow's use of arrowing the CAP instead of using the

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[38] *USS Yorktown (CV-5) Action Report*, Commander in Chief, Pacific Fleet report, Serial 01849 of 28 June 1942, World War II action reports, Modern Military Branch, National Archives and Records Administration, College Park, MD.

[39] Lundstrom, *The First Team: Pacific Naval Air Combat from Pearl Harbor to Midway*, 443.

[40] *Battle of Midway Reports,* CINCPAC: 17 – 28 JUN 42, RG 38, WWII Action and Operational Reports, Box 11, College Park, MD.

[41] Kern, "Striking Eagles," 77.

[42] Lundstrom, *The First Team: Pacific Naval Air Combat from Pearl Harbor to Midway*, 443.

doctrine laid out by the OpNav publication on fighter direction vocabulary, which led to a more formalized and standardized doctrinal language encapsulated in *USF-10A*.[43]

Technically, the Navy was frustrated by the lack of IFF gear and the need for better radio equipment. While the *Enterprise* fighters all had IFF installed, the *Hornet* was only partially equipped, and the *Yorktown* had very few, leading to the FDO wasting valuable time vectoring fighters to visually identify whether bogies were friend or foe.[44] After action reports also identified the need for super-frequency radios to allow FDOs to do their jobs without the risk of revealing their location to the Japanese, who had by this time figured out how to interdict medium high-frequency radios. Additionally, the super-frequency radios would allow FDOs to talk to one another from carrier to carrier so that if an FDO was unable to control his CAP any longer, another FDO could take over without a loss of situational awareness. The very issue that had hamstrung Ham Dow on the Enterprise when FDO Pederson dropped off the net aboard the *Yorktown* when it lost power due to the damage that occurred on 4 June 1942.[45]

The lessons learned at Coral Sea and Midway, alongside many of the men who fought there, would soon make their way back to the States to facilitate a learning organization that was able to apply lessons learned across the theater of operations rapidly. Unfortunately, Admiral Ernest King did make the mistake of supporting the doctrine that forbade any two carriers from operating together in any screen or tactically concentrated formation. However, his insistence on taking the offensive forced the learning organization of the US Navy that had been developed during the interwar period to execute rapid wartime learning cycles to adapt to wartime experiences in innovative ways. The US Navy made the correct decision to rotate many combat

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[43] *Ray Interview*, 5.
[44] Lundstrom, *The First Team: Pacific Naval Air Combat from Pearl Harbor to Midway*, 323.
[45] *Ray Interview*, 9.

veterans stateside to refine techniques and pass their knowledge along to new trainees, permeating the ranks with best practices. On the other hand, the Japanese maintained a rigid manning structure and did not rotate veterans to training billets or even other flying squadrons making losses tough to replace.[46]

For the FDOs of the US Navy, this led to further development of the training occurring at stateside fighter direction schools, which incorporated the lessons learned in combat and the training received in Great Britain. In April 1942 Pacific Fleet directed Commander John Griffin to move its school from San Diego to Pearl Harbor to take advantage of larger facilities and more staff. Griffin was tasked with professionalizing FDOs through rigorous and structured training rather than the ad hoc on-the-job training occurring, reforming fighter direction doctrine, and increasing the number of FDOs from one per task force or fleet to one aboard each combatant ship. The school sought to train officers in obtaining information related to the position of friendly and enemy forces, weather, the tactical situation, and information on radar contacts in Radar Plot, later to become the Combat Information Center. They were further trained on relaying that information to the ship's captain, aircraft flying CAP, and the gunnery officer in a timely manner to ensure the defense of the ship and task force.[47] However, as Ray proposed, the fighter director schools were training excellent radar plotters but were not graduating fighter directors and could not through their current training methods. The schools and the technology were still extremely new and trying to develop a base-line knowledge in a limited amount of time before sending FDOs off to war in the Pacific. However, to develop effective fighter directors the curriculum needed to integrate naval vessels, aircraft, and fighter pilots conducting actual

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[46] Hone, *Learning War: The Evolution of Fighting Doctrine in the US Navy, 1898-1945*, 335; Clark Reynolds, *The Fast Carriers: The Forging of an Air Navy*, (Huntington, NY: R.E. Krieger, 1978) 27, 30.
[47] "This is Fighter Direction," July 1944, 11; "Radar Center Trains Thousands for the Pacific War," September 1944, 35-37; "Fighter Direction begins at St. Simons," January 1945, 6-11 *Combat Information Center Magazine*.

intercepts. Ray's objections were accurate and would lead to more hard-earned lessons at Guadalcanal and further evolution of fighter direction training and doctrine.

GUADALCANAL AND CONTINUED INNOVATION

The actions in the Guadalcanal campaign between August and October 1942 would prove to be so devastating to both fleets that another carrier-on-carrier battle would not occur until summer 1944.[48] In support of Operation WATCHTOWER, TF 61 was composed of TF 18 under the command of Rear Admiral Leigh Noyes aboard the carrier *Wasp*, TF 11 under the command of Rear Admiral Frank Jack Fletcher aboard the carrier *Saratoga*, and TF 16 under the command of Rear Admiral Thomas Kinkaid aboard *Enterprise*. Their objective was to support the amphibious assault and unloading of cargo ships in the seizure of Guadalcanal.[49] However, defending the landing forces required the carriers to remain within sixty miles of the amphibious assault force to provide air coverage until the establishment of land-based air could provide coverage. Tying the carriers to the island's support degraded the carriers' freedom of maneuver and the island topography degraded radar capabilities putting fighter direction and the protection of the carriers at a severe disadvantage. [50]

During the Battle of the Eastern Solomons, 24-25 August 1942, thanks to the increase of fighters aboard the carriers, fighter directors had 98 fighters collectively available aboard the *Wasp, Saratoga*, and *Enterprise*. Aboard the *Enterprise*, Rowe established a carrier CAP of 16-24 fighters from all three fighter squadrons as RED BASE FDO along with a Screening Combat Air Patrol (SCAP) of 8-16 fighters directed by the *Saratoga* FDO aboard the heavy cruiser *Chicago*. BLACK BASE FDO, Lieutenant Robert Brunning, provided coverage to the cruisers,

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[48] Steve Ewing, *Thach Weave: The Life of Jimmie Thach*, (Annapolis, MD: Naval Institute Press, 2004), 81.
[49] John B. Lundstrom, *The First Team and the Guadalcanal Campaign: Naval Fighter Combat from August to November 1942*, (Annapolis, Maryland: Naval Institute Press, 1994), 19, 20, 24, 28.
[50] Ibid, 28; Hone, "Replacing Battleships with Aircraft Carriers in the Pacific in World War II," 64.

destroyers, and transports 60 miles away from the carriers. When the Japanese attacked, the FDOs executed their duties as best they could but trying to defend two largely dispersed threatened locations in supporting the activity on Guadalcanal proved to be beyond their capabilities. Fuel constraints and an inability to determine a priority allocation of forces to provide protection led to poor positioning of fighters at low altitudes and piecemeal commitment that allowed Zeros to swarm and pick off fighters, leading to the loss of twenty US fighters in two days.

Action on the 24th of August 1942 showed Rowe's attempt to utilize the CAP to defend the task force disappointed. Rowe vectored a total of 27 fighters to a location 40 miles northwest of the carriers to investigate an impending attack of what turned out to be only four Zeros. Meanwhile, 18 Japanese carrier dive bombers slipped in, leaving Rowe only six fighters remaining overhead to provide a defense. Further hindering the defense was the establishment of the CAP at too low of an altitude and the inexperienced pilots on CAP that jammed up the fighter direction net with poor radio discipline. The US Navy was fortunate that the attack only caused damage to the *Enterprise* and *North Carolina*.[51]

In October, the Battle of Santa Cruz would again showcase the shortcomings and difficulties fighter direction still needed to overcome. Aboard the *Enterprise*, REAPER FDO, Commander John Griffin decided to keep his CAP over the *Enterprise* and *Hornet* at 10,000 feet to conserve fuel and oxygen, assuming radar would give him enough time to increase altitude when attacked. That decision would be disastrous when radar did not pick up the incoming attack of 55 Japanese aircraft at 17,000 feet at the anticipated range of 75 miles out but instead around 40 miles out. Fighting against the appearance of numerous bogeys on the radar due to IFF issues

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[51] Lundstrom, *The First Team and the Guadalcanal Campaign*, 28, 40, 41, 71, 128, 133, 138.

and losing track of his CAP, Griffin had to rely on spotters on the *Enterprise* deck for information on the incoming attack. Lieutenant Junior Grade McGlinn, FDO aboard the *Hornet*, explained the necessity of "zenith lookouts" used aboard the carriers to accurately understand the air picture within ten miles of the carriers due to the clutter on radar that caused the very confusion Griffin was unable to overcome.

Saved only by the performance of the pilots flying the CAP to hinder the attack, frustrations with the execution of fighter direction were again insurmountable.[52] Radio communication continued to be intermittent at best, making tactical control even between a flight lead and his wingmen difficult. Even when communications worked, the fighter director did not have enough information at times to correctly position fighters or did not give the fighters enough information to execute their mission effectively, as Griffin had failed to relay to CAP pilots whether they were looking for high altitude dive bomber "hawks" or low altitude torpedo plane "fish."[53]

The Battles of the Eastern Solomons and Santa Cruz wreaked havoc on the US and the Japanese naval forces. A tactical victory for the Japanese, the escape of *Enterprise* with her aircraft and most of the aircraft from the *Hornet* was the only thing that prevented a complete disaster for the US and made for a strategic victory. On the other side, the Japanese steamed away with six of their nine carriers sunk in the war to this point and a loss of 119 fighter pilots killed or taken prisoner during action at the Eastern Solomons and Santa Cruz.[54] The Japanese could not afford to replace the loss of materiel and manpower.

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[52] Ibid, 384, 385, 387, 410, 413, 445; *Fighter Director Methods Memorandum by Lieutenant JG, USNR, John A. McGlinn Jr.*, 15 December 1942, Record Group 38, Entry A1 311, CINCPAC Files, Box 24, 2.
[53] Ibid, 411; Kern, "Striking Eagles," 85, 87.
[54] Lundstrom, *The First Team and the Guadalcanal Campaign*, 453, 529; Weapons Systems Evaluation Group, *Operational Experience of Fast Carrier Task Forces In World War II*, 16.

The difficulties and destruction experienced during the Guadalcanal campaign revealed the shortcomings of prewar doctrine and the time to synthesize the lessons learned and disseminate the way forward through new doctrine before major carrier combat operations resumed in summer 1944. In fighter direction, complaints continued to center on the delay in contact reports by FDOs to flight leads, the CAP execution by the FDOs, and communication issues, particularly the reliability of radios and IFF gear.[55] After-action reports described fighter direction as inadequate, ineffective, a disappointment, confused, and disorganized.

Tactically, the CAP was again unable to concentrate forces for the incoming Japanese attacks. Pilots believed the FDO was trying to overcontrol too many small sections rather than massing the CAP, providing estimated altitude, range, and bearing, and letting the pilots figure it out.[56] The FDOs counter-argued and attributed the failures to training methods and a lack of radio discipline on the fighter circuit.[57] In his after-action reports, Fletcher urged the concentration of carriers for mutual support, protection, and the ability to mass the CAP on defense. After action reports also identified that the CAP was not promptly deployed to the proper places to attrite an incoming attack and that intercepting attacks must occur at least 20 miles out. Furthermore, the stationing of the CAP at 10,000 feet to conserve fuel and oxygen and dependence on radar to provide early warning was a crucial mistake made by Griffin.[58] In their after-action reports, Griffin, Dow, and Rowe, among others, recommended pushing the CAP to 20,000 feet and higher anytime raids were expected.[59] McGlinn, FDO aboard the *Hornet*, re-iterated that when an attack was imminent, 10,000 feet was not enough altitude to intercept and

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[55] *Memorandum Report of Fighter Direction during Enemy Attack on Enterprise, 24 AUG 1942*, Enterprise 24 August 1942 to 10 November 1942, RG 38, WWII Action and Operational Reports, Box 967, College Park, Maryland, 16.
[56] Lundstrom, *The First Team and the Guadalcanal Campaign*, 162, 457.
[57] *Memorandum Report of Fighter Direction during Enemy Attack on Enterprise, 24 AUG 1942*, 14.
[58] Lundstrom, *The First Team and the Guadalcanal Campaign*, 162, 164, 458.
[59] *Memorandum Report of Fighter Direction during Enemy Attack on Enterprise, 24 AUG 1942*, 21.

recommended 20,000 feet with half the patrol at 15,000 feet and a special patrol to intercept torpedo planes at lower altitudes.[60] Dow again stressed the need for more fighters aboard the carriers and recommended a fighter-only carrier to improve operations.[61] An effective CAP required a concentration of aircraft to effectively defend the carriers.

Timely and accurate radio communication was also inadequate. McGlinn stressed the need to relay any information on incoming bogies by radio to the controlling FDO even if screening vessels had to break radio silence; flags and blinker reports caused too much delay.[62] Fighter direction brevity terms needed to be updated from one word to identify enemy bombers to the three different types of high or medium dive bombers or low-altitude torpedo bombers. The Air Force Pacific Fleet, *Fighter Director Manual*, released in September 1943, would rectify the problems revealed during the Guadalcanal campaign. It identified high altitude bombers as 'bombers,' dive-bombers as 'hawks,' and torpedo bombers as 'fish.' At the same time, enemy fighters were 'rats,' and friendly fighters 'chickens.' The manual also stressed the need to concentrate the CAP at an altitude advantage and for FDOs to provide concise information on radar contacts. The doctrine dictated that fighters would announce their presence, numbers, call signs, fuel endurance, and altitude to the FDO when they arrived on station.[63]

Technically, the shortcomings with the CXAM radar continued to handicap an FDO's ability to determine a good bearing on a contact. The large size of the blips on the A-Scope screen that provided radar operators with contact information made it difficult to determine direction and altitude. Radio shortcomings continued the push in after-action reports for UHF radio and recommendations to establish interplane communications between a section leader and

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[60] *Fighter Director Methods Memorandum by Lieutenant JG, USNR, John A. McGlinn Jr.*,1-3.
[61] *Interview of Commander L.J. Dow*, 7.
[62] *Fighter Director Methods Memorandum by Lieutenant JG, USNR, John A. McGlinn Jr.*, 3.
[63] Kern, "Striking Eagles," 91, 121.

wingman on a different net to free up the fighter direction net. Dow stressed the need for UHF radios to enable radio communications that the Japanese could not intercept, allow for better control of the CAP, and enable FDOs to bring in lost pilots without concern for the Japanese being able to get a bearing on the radio transmission.[64]

In addition to looking at their own battle experiences and lessons learned, the US Navy sent veterans to Great Britain to look at how Allies were training and executing fighter direction to improve the organization. FDOs like Lieutenant H. A. Rowe learned their craft in Great Britain in 1941, fought with the Pacific Fleet, and again went back to Great Britain in early 1943 to further US Navy capabilities. In his analysis of British fighter direction, he saw that it received the number one priority since they utilized carriers to support convoys and landing forces making their carriers primarily defensive units. Rowe pointed out that even though the British typically only had ten to twelve fighters operating on a carrier at a time, their focus on defense meant they could get about as much practice in a day as US fighters received in a couple of months of preparation. Rowe also highlighted British radio discipline and voice procedures, which they practiced in telephone boxes back in Britain. He felt they made their radio voice communications "infinitely smoother" than American operations and pressed the need for standardized brevity terms and communication training stateside.[65]

Many also pointed to the shortcomings or lack of necessary equipment and the level of training occurring stateside as to why fighter direction continued to be a disappointment. While the CXAM-1 could detect aircraft up to eighty miles away when it was working correctly, US Navy inspection reports found that it was very unreliable. The introduction of the SC-1 radar in

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[64] Lundstrom, *The First Team and the Guadalcanal Campaign*, 162, 458.
[65] *Interview of Lieutenant H.A. Rowe, USN, Fighter Director, USS Enterprise, 2 March 1943,* Record Group 313, Entry P10436, COMNAVEU General Administrative Files, 1939-1944, Box 51, 1, 2, 5, 6.

1942 provided a much more reliable radar, but it only had a range of sixty-three miles and was still only entering service in small numbers at this point.[66] Dow re-iterated that fighter director operations continued to suffer from a lack of people with experience. He pointed out that while the fighter director school was doing great work in producing technical experts, he felt on-the-job training was more beneficial. It allowed new FDOs to work with the experienced FDOs aboard the carriers in actual battle to learn how to work directly with the fighters and work through the issues that occur with implementing radar technology. The increased production and availability of radar and IFF to ensure situational awareness of the air picture throughout the fleet, the installation of Position Plan Indicator (PPI) aboard surface vessels, and the establishment of fighter directors aboard all the ships in a task force, would soon improve fighter direction.

While outside the scope of this paper, discussions at this time also started to focus on trying to execute night fighter direction. Further enhancements in radar aboard the ships and installing radar in fighters would be necessary to conduct fighter intercepts at night. At this time, fighter directors still had to rely on experience to provide a best guess estimate of altitudes, allowing the pilots to make visual contact during the day, but visual contact would be impossible at night.[67] Increased radar production would eventually enable the installation of radar aboard aircraft and the execution of the BATCAP to defend against Japanese attacks at night.

PAC-10 / USF-10A

Following the destruction to both fleets caused by the fighting at Guadalcanal, the US Navy looked to take advantage of the operational pause to develop new doctrine to gain and maintain the offensive initiative. Debates had raged in the service over carrier tactics for months,

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[66] Kern, "Striking Eagles," 88-89.
[67] *Dow Interview*, 10, 17.

with leaders drawing different conclusions from the same events. To resolve the issue, Rear Admiral Forrest Sherman and Captain Herbert Spencer Duckworth conducted extensive trials and experiments in carrier tactics at Pearl Harbor in early 1943.[68] Unlike the war games discussed previously during the interwar period that lacked enough carriers or the emergent technologies of radar, radio, and IFF to facilitate fighter direction, Sherman and Duckworth were able to experiment with numerous ships and new technology. The *Enterprise, Essex, Yorktown, Lexington,* and three new *Independence*-class light carriers, all with four-channel very-high-frequency (VHF) radios for the fighter direction teams, PPI radar scopes for the new SK (air search) radars, and the new F6F Hellcat with IFF transponders on all aircraft were made available for the trials.

Sherman and Duckworth then provided their results to a team of three officers that had been tasked by Nimitz on April 13, 1943, to rewrite the "Standard Cruising Instructions for Carrier Task Forces," which would become *Pacific Fleet Tactical Orders and Doctrine (PAC-10)* issued on June 10, 1943.[69] Wartime experiences, the outcomes of the trials, and advanced technology showed that advances in radar along with more effective fighter direction techniques allowed groups of carriers to pool their resources and offer mutual support. The debate was over; the US Navy abandoned single-carrier formations and formed task forces around multiple carriers operating together.[70] The doctrine was an innovation in that it combined existing tactical publications, tactical bulletins, task force instructions, and battle organization doctrine into one publication that facilitated interchangeable ships between task groups. The doctrine also enabled

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[68] Hone, "Replacing Battleships with Aircraft Carriers in the Pacific in World War II," 63.
[69] Ibid, 63.
[70] Hone, *Learning War: The Evolution of Fighting Doctrine in the US Navy, 1898-1945*, 255.

the rapid operational tempo required by Nimitz and shifted the development of tactical doctrine to the fleet level, increasing the effectiveness of all units.

While prewar doctrine had focused on fleet tactics and decisive battle, neglecting the tactical details of employing smaller forces, battle experience would reveal the necessary focus on "minor tactics" that *PAC 10* and *USF-10A* would provide. *PAC-10* looked to allow forces to "join at sea on short notice for concerted action against the enemy without interchanging a mass of special instructions. To alleviate issues that had occurred with IFF and the cluttering of radar with friendly bogies, *PAC-10* dictated that IFF would be on at all times except when within 25 miles of known enemy forces, and if IFF is inoperable, aircraft will identify themselves by two circles of four-minute duration approximately 20 miles away. Drawing on the lessons learned at the Coral Sea and the Eastern Solomons, *PAC-10* directed tactical concentration on CAP, and that radio silence should be broken upon the identification of the enemy because rapid communication outweighed any further advantages of radio silence to ensure the most effective fighter direction and coverage.[71]

Released on February 1, 1944, *USF-10A* would succeed *PAC-10* when the US Fleet followed the lead of the Pacific Fleet, maintaining a majority of the content but providing far more tactical detail.[72] *USF-10A* provided a detailed discussion of suspected enemy air attacks from torpedo bombers at low altitudes, horizontal bomber attacks at 10-12,000 feet up to different types of high angle bomb attacks at 22-37,000 feet to ensure FDOs stacked their CAP from a low-level air patrol at 1,500 feet up through a medium and high-level CAP at the FDOs discretion based on fuel and climb rates to intercept incoming attacks based on previously

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[71] *Current Tactical Orders and Doctrine, US Pacific Fleet, or PAC-10, Commander-in-Chief, US Pacific Fleet, June 1943*, IV-2, Box 61, US Navy and Related Operational, Tactical, and Instructional Publications, V, 41, 56, 58.
[72] Hone, "Replacing Battleships with Aircraft Carriers in the Pacific in World War II," 63; Hone, "US Navy Surface Battle Doctrine and Victory in the Pacific," 75, 76.

learned lessons. The document also prescribed that the assignment of fighter direction ship would typically be assigned to the aircraft carriers but that every ship with a CIC should have proper training and be capable of controlling aircraft. In addition to the influx of radar into the ships of the US Navy, *USF-10A* further enabled fighter direction with the establishment of phonetically named radar guardships to screen the task force and provide earlier warning and detection. Guard Able was tasked with long-range air search, Baker provided short-range air search, Charlie provided medium-range air search, and Dog provided low flying aircraft search. These radar guardships were required to detect and maintain a continuous track on all enemy and friendly aircraft and funnel that information to the fighter direction ship(s) via the inter-fighter direction channel to provide an expanded radar picture of air activity and facilitate the intercept of incoming raids.

Finally, *USF-10A* allocated an entire section specifically to fighter direction doctrine. It describes how a fighter director is responsible for providing effective protection against air attacks using defensive fighters by providing fighter coverage anytime an air attack is likely, not allowing any attack to come in entirely unopposed, by keeping fighters between the raid and the base (not letting fighters vacate to track down raiders), utilize a number of fighters equal or greater than the enemy, through the use of good strict communications and the optimum attack position. To ensure that the fleet executed fighter direction doctrine as promulgated by the doctrine, *USF-10A* specifically stated that FDOs were responsible for the "thorough indoctrination and training of flying and non-flying personnel concerned with fighter direction."[73] With these documents in hand, the fast carriers established, and methods to ensure

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[73] *Current Tactical Orders and Doctrine, US Fleet, U.S.F 10A, Commander-in-Chief, United States Fleet, 1 February 1944*, WW2 Bates-Leyte Collection, Records of the Office of the Chief of Naval Operations, Record Group 38, National Archives, box 16, 4-20, 4-24 to 4-25, 6-1, 6-13, 6-21 to 6-23.

the doctrine was shared and executed, the innovation of the US Navy and its fighter direction would protect the fleet through the use of superior technology and techniques that would facilitate a high tempo offensive across the Pacific to the Japanese home islands.

THE MARIANAS TURKEY SHOOT

In addition to the proliferation of ships with improved technologies and updated doctrine, the US Navy continued to improve the training executed at its fighter director schools. Fighter director schools at St. Simon's Island, Georgia, and Camp Catlin, Hawaii, taught mainly reservists in the tactical applications of radar.[74] The school's curriculum of nine weeks took students through the application of air-search radar, emphasizing fighter direction and enemy intercepts with airborne pilots, the utilization of IFF, target plotting, fighter direction voice code to streamline communications, and how to estimate altitudes utilizing the fade method on the A-Scope.[75] Upon arrival at their new ships following graduation, new fighter directors typically found they needed to supervise the installation of the complement of three radar for a carrier, establish their radar plot in the Combat Information Center (CIC), train and develop their radar crew, and most likely explain the capabilities and limitations of their team to their leadership who did not learn about the new technology at Annapolis.[76] The forthcoming Marianas operation would test the ability of the fighter direction school to produce competent FDOs that could integrate and track a large number of assets to provide the best antiaircraft defense of over 600 vessels in TF 58, including seven heavy and eight light fast carriers, seven fast battleships, three heavy and seven light cruisers, 60 destroyers, and over 24 submarines.[77]

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[74] John Monsarrat, *Angel on the Yardarm: The Beginnings of Fleet Radar Defense and the Kamikaze Threat* (Newport, RI: Naval War College Press, 1985), 33.
[75] "Radar Center Trains Thousands for the Pacific War," 35.
[76] Monsarrat, *Angel on the Yardarm*, 46.
[77] Reynolds, *The Fast Carriers*, 170.

Under Admiral Raymond A. Spruance's command, TF 58 looked to protect US forces on Saipan as well as those waiting to take Guam and Tinian and their transport and supply ships. Expecting a counterattack on the morning of 19 June 1944, Spruance separated his four carrier task groups twelve miles apart from each other and awaited the attack.[78] Looking out from the *Lexington*, her task group stretched out to the horizon with fighters from all four carriers providing CAP and a screen of battleships, cruisers, and destroyers on the surface providing a defense that would be difficult to penetrate.[79] Before 10 a.m., Vice Admiral Jisaburo Ozawa, Commander-in-Chief of the Combined Fleet, would launch the first of four large raids aimed at the American task groups amounting to over 400 carrier and land-based aircraft by the end of the day. The primary defense of the fast carriers was provided almost flawlessly by the CAP interceptors and the skillful FDOs that utilized their radar equipment to identify the incoming attacks at ranges over 100 miles and vectored fighters to intercept at up to 55 miles away from the task force. [80] So few attackers would penetrate the CAP that the *Langley* never even fired her antiaircraft guns![81] By the end of the day, the Japanese had lost over 300 aircraft in "The Great Marianas Turkey Shoot."[82] The ability to defend against attacks at scales that had not been seen before seemed to finally prove the indispensability of fighter direction as a legitimate defense of the carriers.

However, there are those that may argue that the evolution of fighter direction mattered little in the outcome of the war considering other factors. First, in the face of overwhelming materiel, the Japanese simply could not compete with the industrial might of the US. By the end

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[78] Monsarrat, *Angel on the Yardarm*, 89.
[79] Ewing, *Thach Weave*, 116.
[80] Reynolds, *The Fast Carriers*, 194, 221.
[81] Monsarrat, *Angel on the Yardarm,* 89.
[82] Reynolds, *The Fast Carriers*, 221.

of the war, the US had employed twenty-one fleet carriers and nine light carriers, losing four fleet carriers in 1942 and one light carrier in 1944. On the other hand, the Japanese entered the war with nine fast carriers and would only commission eleven more during the war, losing all but four that would be found damaged in Japanese ports at the end of the war. Second, in support of the first factor, some may point to the unsustainable losses in Japanese capabilities and the degradation of its pilot training as being more significant to the outcome of World War II in the Pacific. At the beginning of the war, IJN pilots received an average of 700 hours of training while US Navy pilots received 305 hours. By the end of the war however, IJN pilots were only receiving 100 hours of training while US pilots received 525 hours.

However, these arguments miss the mark. It can be seen that at the beginning of the war, the Japanese had more carriers and aircraft (2,675 versus 1,333 US Navy aircraft). [83] The IJN was unable to capitalize on their overwhelming materiel capability because they did not have the doctrine or adaptability in place to do so. The IJN made the critical mistake of not rotating veterans back home to train new pilots leading to the severe degradation in pilot training later in the war as their forces were attrited by the learning organization created by the US Navy and the FDOs that directed the defense against their attacks. Action in the Marianas led Vice Admiral Marc Mitscher to state that the success "proved that the long and costly efforts in research, training and the practical applications of radar have not been in vain." On the other side of the coin, Ozawa attributed US superiority to "the use of radar, interception of radio message, and intercepting by radar of Japanese air attacks which (American planes)…can catch and eat up whenever they want to."[84] With the quantity and quality of Japanese aviation in rapid decline and

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[83] Weapons Systems Evaluation Group, *Operational Experience of Fast Carrier Task Forces In World War II*, 7, 21, 47, 82.
[84] Reynolds, *The Fast Carriers*, 221.

the Philippine Sea bringing an end to carrier duels, fighter direction had shown just how critical it was.

With the overwhelming victory attained in "The Marianas Turkey Shoot," it seemed as though the combination of FDOs and the fighters on CAP had proved their effectiveness; however, the US Navy was not the only side to learn from the campaign. While VHF had secured radio communications, after-action reports would show that radio discipline remained an issue. On the other hand, the action proved the legitimacy of *PAC-10* in executing a rapid offense with the proper defensive measures in place, including CICs in all the surface ships. However, Mitscher was soon to realize and release special task force instructions in May of 1944. It required each Task Group to assume their own fighter direction control upon separation for launches and recoveries. FDOs would be required to maintain a continuous plot of all friendly aircraft in the event of lost communications to avoid friendly fighters from one task group engaging friendly fighters of another task group due to lost communications and a lack of situational awareness.[85] At the same time, as Ozawa stated, the Japanese realized their inferiority when it came to radar and the destruction it was causing on their massed raids, as could be seen during the Marianas Turkey Shoot. Adaptation would lead to smaller raids and kamikazes to overcome the degrading quality of their pilots due to a lack of training hours. The US would need to continue revolutionizing fighter direction techniques to deal with the new threat.

KAMIKAZES AND THE END OF THE WAR

The Battle of Leyte Gulf marked the transition in Japanese tactics to kamikazes for the remainder of the war. In late 1944, the IJN decided to execute kamikaze tactics in a desperate attempt to overcome the technological superiority of US aircraft and equipment. The IJN realized

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[85] Hone, "Replacing Battleships with Aircraft Carriers in the Pacific in World War II," 65, 70.

that despite their increased aircraft production, the disparity in pilot training between them and the Americans was growing. With inexperienced pilots on hand, they decided to use them in the manner likely to bring about the highest return. Analysis would show that kamikaze hits were three times more effective than conventional bombs in putting ships out of action as measured by repair time.[86]

Fortunately, the US Navy counteracted the kamikaze threat because of the innovative transformation facilitated by *PAC-10*, *USF-10A*, and the utilization of emergent technologies by FDOs that would sustain US Navy operations to ultimate success.[87] Again, the US Navy conducted trials and experiments to find a solution. The MOOSETRAP exercises at Ulithi in late 1944, led by Vice Admiral John S. McCain and Thach, would provide those answers by creating the "Thatched Roof" three-strike system, later called the "Big Blue Blanket."[88] Aboard the carriers, FDOs worked hard to indoctrinate the new pilots that came aboard into the doctrines and procedures of the task force, finding them eager to absorb all of the necessary details to be successful.[89] On the surface, the Navy placed two radar picket destroyer groups approximately fifty miles forward of the task force moving toward the enemy land bases, named Tomcat and Watch Dog, like three points of a triangle. Each group had a fighter director aboard, which would relay information to the task force FDO. Additionally, three to four task groups within the task force were always kept within distance to provide mutual fighter defense.[90]

In the air, the US Navy would see their compliment of fighters per carrier jump from 18 at the Marshall Islands to 55 at Leyte Gulf in October 1944 to 73 at Okinawa in April 1945.[91]

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[86] Weapons Systems Evaluation Group, *Operational Experience of Fast Carrier Task Forces In World War II*, 20, 68.
[87] Hone, *Learning War: The Evolution of Fighting Doctrine in the US Navy, 1898-1945*, 292-293.
[88] Ewing, *Thach Weave*, 146, 149.
[89] Monsarrat, *Angel on the Yardarm,* 97.
[90] Ewing, *Thach Weave*, 147.
[91] Weapons Systems Evaluation Group, *Operational Experience of Fast Carrier Task Forces In World War II*, 50.

The increased fighter strength facilitated one fighter patrol over the enemy airfield while a second prepared for takeoff, and a third was moving to or from a target area or being re-armed.[92] Above the task force, A JACKCAP of 5 to 6 units of 2 to 4 fighters flew at a low level outside the screen to intercept torpedo bombers, DADCAP from dawn to dusk over the carriers replaced by BATCAP for dusk patrol, and RAPCAP or radar picket planes and SCOCAP or scouting line planes over the screening destroyers, all to provide CAP coverage for the entire task force. [93] While several aircraft carriers sustained damage in 1945, the exponential growth in fighters and new fighter direction techniques enabled the US Navy to operate off the coast of Japan in the face of kamikaze attacks without suffering unsustainable losses.[94]

Learning from the overwhelming loss at The Battle of the Philippine Sea caused by concentrating its aircraft in four air attacks, Japanese kamikaze attacks were characterized by small, numerous attacks hoping to avoid radar detection or over-saturate the radar picture with too many enemy aircraft to keep track of. For example, on November 25, 1944, in support of landings at Leyte Gulf, the FDO aboard *Lexington* had to deal with 27 raids but by March 18, 1945, he had to deal with 51 raids in a single day! In the final desperate acts by the IJN to slow the US advance, FDOs would have to deal with attacks such as Kikusui No. 1 launching close to 700 planes in 3-4 plane attack formations with the order that all pilots consider themselves kamikazes on April 6, 1945.[95] In response to such overwhelming numbers in small raiding parties, it is hard to overstate the exceptional job carried out by the FDOs and the fighters above that vectored out on CAP to intercept these large forces in addition to providing information to the antiaircraft batteries across the task forces.

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[92] Reynolds, *The Fast Carriers*, 290.
[93] Ibid, 290.
[94] Kern, "Striking Eagle," 123.
[95] Monsarrat, *Angel on the Yardarm,* 114, 150, 157.

To be clear, the US Navy's losses during the last-ditch kamikaze efforts by the Japanese were heavy. However, the ability of the US Navy to transform throughout the war and rapidly execute innovative tactics and doctrine ensured a successful counterreaction to the kamikaze threat. The increased quantity of fighters and surface vessels alongside the emergent technologies of radar and IFF contributed to success. But it is hard to overstate the crucial role that the doctrine and the fighter directors that integrated those systems played. The losses sustained during the final push towards the Japanese home islands were sustainable due to the reforms made in doctrine and the distribution and utilization of superior technology that allowed FDOs to provide a strong defense of the fast carrier task forces. [96]

CONCLUSION

Looking back on World War II in the Pacific, it is clear that the evolution of fighter direction and the US Navy's ability to rapidly integrate emergent technologies was critical to success. During the interwar period, the US Navy was unable to develop appropriate defenses for the carriers because of the critical role emergent technologies not yet developed would play. However, the US Navy was able to develop a learning organization that was able to rapidly learn from and adapt to hard-fought battle experiences along with the systems to quickly circulate that information. In 1943, the innovative and transformative fighter direction doctrine published in *PAC-10* and *USF-10A* synthesized the lessons learned from the first two and a half years of war and pushed out the best practices that enabled FDOs to utilize emergent technology and execute their duty of providing fighter intercept to protect the US Navy and win in the Pacific. US Navy leaders realized the necessity of seizing the initiative and rapidly executing expansive offensive action that could only be successfully achieved through the integration of forces and a focus on

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[96] Kern, "Striking Eagles," 124.

the minor tactics that *PAC-10* and *USF-10A* facilitated. This new approach, based on interchangeable ships and leaders that were distributed over a wide area but able to provide mutual support and defense, was revolutionary. The new doctrine solved the shortcomings of prewar doctrinal development by relieving task force commanders of the necessity to create battle plans and doctrine for their forces and allowed for ships and crew to be easily interchanged.[97] The learning system designed in the prewar period and revolutionized through *PAC-10* and *USF-10A* facilitated the US Navy's ability to exploit lessons learned in combat and develop new tactics, plans, and force structure and led to decisive victory in the Pacific.[98]

[97] Hone, "US Navy Surface Battle Doctrine and Victory in the Pacific," 93.
[98] Hone, *Learning War: The Evolution of Fighting Doctrine in the US Navy, 1898-1945*, 317.

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