Catapult officer signals launch as A-4 Skyhawk starts down flight deck of USS *Coral Sea* during operations in South China Sea, March 24, 1965 (U.S. Navy/James F. Falk)

Adapting to Disruption

Aerial Combat over North Vietnam

By Robert G. Angevine

Military organizations devote substantial effort to anticipating and preparing for future conflicts, yet they rarely get things exactly right. Inevitably, the enemy does not operate as predicted, tactics are not as successful as desired, weapons do not perform as planned, and organizations and policies are not as effective as expected. Successful adaptation to such disruptions is thus a key component of military effectiveness.[1]

The 2018 National Defense Strategy calls for a "rapidly adapting Joint Force."[2] Successful military adaptation typically consists of several elements. The first is cognitive adaptation. In order to adapt to a disruption, a military organization must first recognize that the problem exists. Once the disruption is acknowledged, the organization may adapt its tactics, technology, institutions, and policies to deal more effectively with the challenge.

During the first four years (1965–1968) of the U.S. military's participation

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in aerial combat over North Vietnam, both the U.S. Navy and the U.S. Air Force experienced unexpectedly high losses. The Air Force kill ratio in Korea was 4.7 to 1 from 1950 to 1952 and 13.9 to 1 from 1952 to 1953. Between 1965 and 1968, however, U.S. aircraft downed 118 North Vietnamese MiGs and suffered 55 losses, a kill ratio of just 2.1 to 1. From August 1967 to February 1968, U.S. fighters suffered an adverse kill ratio against the most advanced Vietnamese fighter, the MiG-21, losing 18 aircraft and downing only 5.[3] The cessation of bombing in 1968 gave the Navy and the Air Force a chance to respond to the disappointing performance of their fighter planes. The resumption of the bombing campaign in 1972 provides an opportunity to evaluate how well the two Services adapted to disruption. A comparison of Navy and Air Force efforts to adapt their approaches to aerial combat also illuminates who typically drives adaptation, how long it takes, what contributes to success, and what the joint force can do to avoid or minimize future disruptions and to adapt to the ones that inevitably occur.

Background

In early April 1965, U.S. aerial forces clashed with Soviet-built Vietnamese MiG fighters for the first time. During these early encounters, U.S. pilots found that engaging in close-in, turning dogfights with the old but highly maneuverable gun-armed MiG-17 was dangerous. By the end of July 1966, the Navy had downed 9 MiG-17s and lost 3 aircraft while the Air Force had downed 10 aircraft and lost 6. The more advanced MiG-21, which was evaluated as equal or superior to the most advanced U.S. fighters and carried two Atoll infrared missiles, first appeared in the skies over Vietnam in early 1966. The MiG-21s had little impact until October 1966, when they shot down an Air Force F-4C and a Navy F-4B with Atolls. In 1967, however, the MiGs adopted new tactics. The MiG-17s tried to lure the F-4s into slow-speed, turning fights by employing circling formations at low altitudes over the likely routes of U.S. strike forces. The MiG-21s, guided by ground controllers, approached U.S. attack formations at low altitudes to avoid radar. They gained positions behind the formations, then climbed rapidly and made a single high-speed pass, often catching U.S. pilots unaware. From July 1967 to March 1968, the United States lost 26 aircraft while downing only 24 MiGs. The kill ratio remained in favor of North Vietnam until the bombing was halted on October 31, 1968.[4]

Both the Navy and the Air Force struggled to counter the MiG challenge. During the final 13 months of Operation *Rolling Thunder* (October 1967–October 1968), Navy pilots shot down only nine MiGs against six losses. Meanwhile, the Air Force registered just 27 kills and lost 24 aircraft from October 1967 through March 1968.[5]

Cognitive Adaptation

The Air Force and the Navy recognized relatively quickly that U.S. air-to-air combat performance was not as good as expected based on U.S. performance in the Korean War, and they took action. However, the two Services came to different conclusions regarding the sources of disruption and thus pursued different adaptation strategies. The Air Force quickly decided that the problems were largely technical and therefore sought to adapt its technology. The Navy, in contrast, initiated a comprehensive investigation of air-to-air performance and adopted a broader adaptation strategy.

The Air Force drew on an analysis of air-to-air engagements conducted by the Institute for Defense Analyses in response to a request in 1966 from the Deputy Director, Tactical Warfare Programs, Office of the Director of Defense Research and Engineering. The study, called "Red Baron," found that many of the Air Force losses came when MiG-21s attacked almost unseen from the rear, catching Air Force pilots by surprise. The Air Force concluded that the problems were largely technical and pursued a number of measures to increase its pilots' situational awareness.[6]

The Navy also recognized early on that its fighters were not performing as well as had been expected. In early 1966, Chief of Naval Operations (CNO) Admiral David L. McDonald directed the creation of Project Plan to review the effectiveness of Navy missiles and air-to-air tactics. As air-to-air performance deteriorated in the spring of 1968, the new CNO, Admiral Thomas Moorer, initiated a comprehensive investigation. He ordered Captain Frank Ault to examine all aspects of the situation, from the manufacturing of the planes, their radars, and their armament to the preparation of the pilots. Ault was ordered to figure out why the Navy pilots were downing so few MiGs and then to come up with fixes that would improve air-to-air performance by a factor of three.[7]

The Ault Report concluded that there was no single explanation for the poor air-to-air performance of Navy fighters. Moreover, incremental improvements of existing practices would be insufficient to solve the problems. Instead, the report concluded, "The need for new approaches and innovations appeared self-evident." It discussed extensively how to improve missiles, but a small section also focused on air-to-air training. The report argued that many of the missile problems and overall air-to-air problems in the Navy were because F-4 crews were poorly trained in air-to-air combat, and it recommended immediately establishing a training program.[8]

Tactical Adaptation

Tests conducted soon after aerial combat began over Vietnam indicated that standard Air Force fighter tactics were not effective. The primary Air Force fighter formation at the beginning of the Vietnam War, the Fluid Four, was the same one used in World War II and Korea. The Fluid Four formation called for four airplanes, divided into a lead element and a second element of two planes each, to operate together. The two pairs supported each other, but the flight leader usually made all the decisions for all four planes and was the primary shooter. The wingmen were

tasked with protecting the flight and second element leaders and were not expected to fire their weapons. Because the wingmen were typically less experienced than the leaders, they often found it difficult to remain in formation when the flight and second element leaders maneuvered aggressively.[9]

In contrast, Navy air-to-air tactics called for a two-ship formation. This formation made better use of the planes' potential firepower and enabled them to provide greater mutual support than the four-ship formation. Widespread recognition of the Fluid Four formation's tactical deficiencies prompted Air Force units to increase the separation between aircraft and adopt different configurations, but the Air Force continued to use the four-ship formation until the end of the war. Tactical Air Command (TAC) and the Fighter Weapons School (FWS) at Nellis Air Force Base in Nevada were vehemently opposed to changing tactics. Many Air Force officers believed the reason for the Service's continued adherence to the four-ship formation was that the primary alternative, the two-ship formation, was so closely associated with the Navy.[10]

Technological Adaptation

Both the Navy and the Air Force also tried to adapt their technology to improve air-to-air performance. They sought to improve the planes, their armament, and the situational awareness of the pilots. Both Services made strides in all three areas.

Planes. The primary fighter plane for both Services during the Vietnam War was the F-4 Phantom. Originally designed as a two-seat fleet air defense interceptor, the F-4A was delivered to the Navy in 1960. The Air Force soon adopted the F-4 and, after making minor modifications, introduced it to service as the F-4C in 1963. The F-4 was fast (Mach 2.2), could operate over a long range, and had a powerful radar and heavy armament, but it was not designed for aerial dogfighting. The F-4 did not maneuver as well as the MiGs it faced, it lacked a gun, and it produced a smoky trail when the afterburners for its twin engines were not engaged. Visibility from the front and rear cockpits was poor, and the layout of switches and controls in the cockpit, especially the missile firing controls, was a "nightmare" according to one F-4 pilot. The F-4 also had a tendency to go out of control when maneuvered at high angles of attack—that is, at low speed.[11]

In the short term, both Services sought to adapt the F-4 by addressing some of the weaknesses exposed during the early air battles in Vietnam. In 1966, the Navy introduced the F-4J, which emphasized improved air-to-air combat capability. Also in 1966, the Air Force announced its plans to acquire the F-4E, which solved many of the technical deficiencies of earlier Air Force F-4 models. It had a new wing with hydraulically operated slats on its leading edge that improved the maneuverability and limited the danger of spins.[12]

Armament: Missiles. Among the reasons for the disappointing performance of U.S. fighter aircraft during the first 4 years of the war in Vietnam was the ineffectiveness of the missiles the aircraft carried. Navy and Air Force F-4s carried both the AIM-7 Sparrow radar-guided missile and the AIM-9 Sidewinder infrared-guided missile. During *Rolling Thunder*, about 330 AIM-7s were fired for about 27 kills, a success rate of less than 9 percent. The AIM-9B Sidewinder was slightly more effective: about 15 percent of its shots were kills.[13]

The Services and the Department of Defense were shocked by the poor missile performance—pre-war missile testing programs had predicted much higher levels of effectiveness. Initial research and development tests for the AIM-7 produced 80 to 90 percent kill rates. Operational tests predicted that the AIM-7 would hit 71 percent of time; the AIM-9 was expected to hit 65 percent of the time.[14]

The missile testing program, however, did not reflect how the missiles would be used. Almost all the tests were against non-maneuvering drone targets at high altitudes, many of them with artificially strengthened radar returns. The missiles for the tests were carefully handled, maintained, and stored. Any test failure was dismissed as the result of poor maintenance or an improperly executed test instead of the product of a flawed design.[15]

The ineffectiveness of U.S. air-to-air missiles provoked a number of efforts to improve their performance. The Navy and Air Force teamed up to try to improve Sparrow performance with the introduction of the AIM-7E in mid-1966, but the new version made only minor improvements over the previous model and had little impact. Another effort to improve the Sparrow was the AIM-7E2, introduced in August 1968. Called the "Dogfight Sparrow," the AIM-7E2 had a significantly shorter minimum range and was more capable against maneuvering targets, but it saw only limited use before the end of *Rolling Thunder* in 1968. It proved only a marginal improvement. During the entire course of the war (1965–1973), 281 AIM-7E2s were fired and achieved only 34 kills—a 12 percent success rate.[16]

Meanwhile, the Services followed different paths to improve their heat-seeking missiles. The Navy decided to improve the AIM-9B by adding a cooled seeker. To ensure that there was sufficient coolant for long engagements, the Navy mounted the liquid coolant bottle in the missile launch rail. The Navy introduced the AIM-9D in June 1966.[17]

The Air Force, in contrast, abandoned the AIM-9B and revived its AIM-4 Falcon infrared-guided missile, which had been beaten out by the Navy-developed AIM-9 in 1957. Like the AIM-9D, the AIM-4D had a larger engagement envelope than the AIM-9B and a cooled seeker. Unlike the AIM-9D, however, the AIM-4D stored its coolant in the missile body, which meant the supply of coolant was small and the missile had to be fired within 2 minutes of being armed or it would not work. The Air Force also chose to wire its newest F-4 model, the F-4D, to carry only the Falcon; it was not wired to carry the Sidewinder.[18]

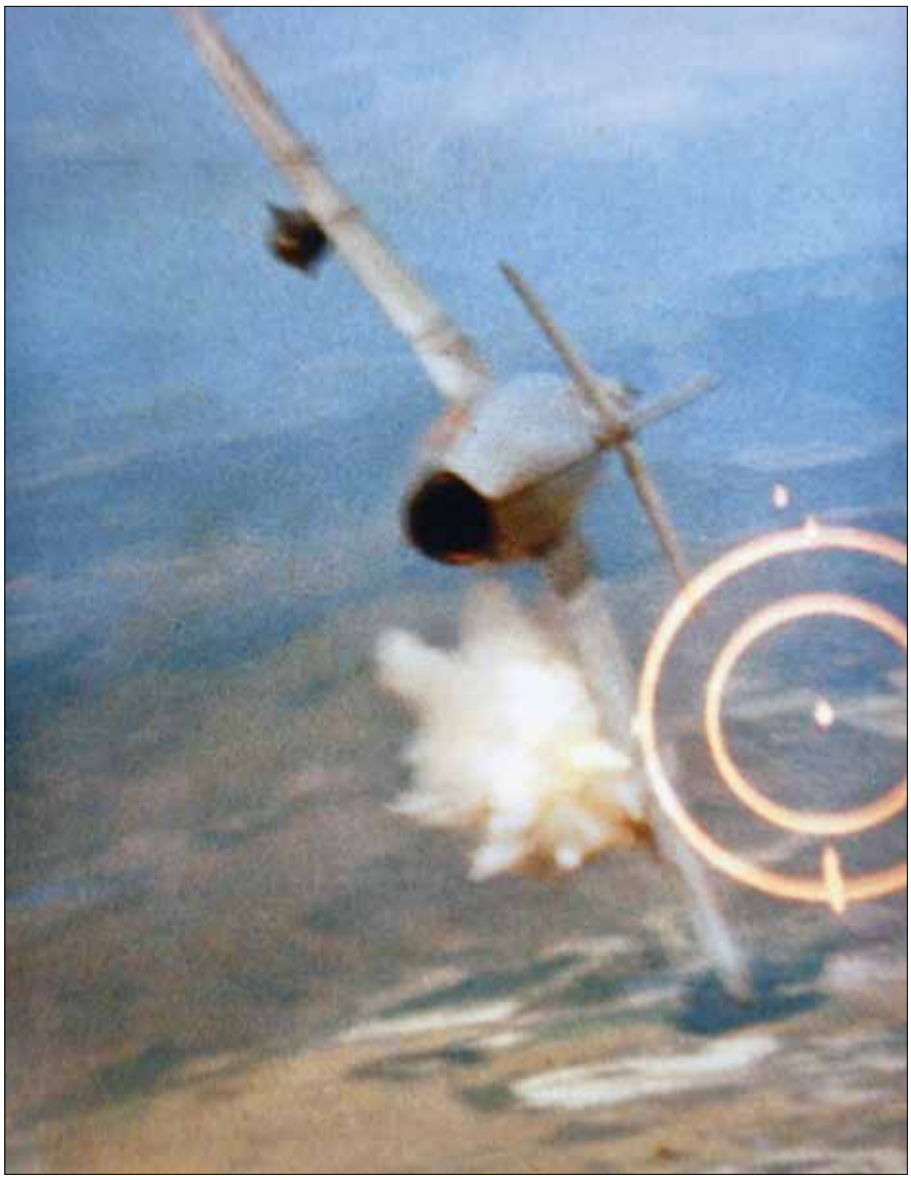
The AIM-4D performed poorly in combat and forced the Air Force to scramble for a replacement. Less than

3 months after the Falcon's introduction into theater, Headquarters Pacific Air Forces decided to replace all the AIM-4Ds on its F-4Ds with AIM-9B Sidewinders. The F-4Ds all had to be rewired to carry the old missile. Upgrading to the Navy's AIM-9D would have required modifying all the Air Force F-4 missile rails. Navy and Air Force AIM-9 rails were incompatible until the late 1970s.[19]

Armament: Guns. The prevailing sentiment within the Pentagon in the early 1960s was that future air combat would consist of long-range radar detection and missile exchanges; thus, fighters would not need guns. By the spring of 1967, however, a number of Air Force reports had concluded that the lack of a gun on the F-4 was one of the reasons for the low kill rate in encounters with MiGs. The advocates of guns on fighters were able to cite the analysis of aerial combat over Vietnam to justify repurposing a podded gun system being developed to enhance the F-4's air-to-ground capabilities and use it for air-to-air combat. The first gun pods for the F-4 began arriving in Southeast Asia in April 1967 and were in use a month later. The pod scored four kills the first eight times it was fired.[20]

Meanwhile, the F-4E—the Air Force's newly announced version of the F-4—was equipped with an internal gun in addition to its other improvements. Reflecting the Air Force's faith in technological solutions, some Air Force pilots believed that the F-4E would solve their aerial combat problems. As Major William Kirk noted, "Eventually we're going to have the E-model airplane with the internal gun. That's the answer. That's obviously the answer." The first F-4Es did not deploy to Southeast Asia until November 1968, however, and problems with the aircraft slowed deployment. By mid-1971 there were only 72 F-4Es in theater.[21]

The Navy never did adopt a gun pod for the F-4 because it would have prevented its planes from carrying an external fuel tank on the plane's centerline, and employing wing tanks was very difficult given the cramped flight deck on board a carrier. The Navy also eschewed an internal gun on later models of the F-4, such as the F-4J, in part because it already had a gun-armed fighter, the F-8, and because the Navy devoted more effort to training its pilots on how to employ the F-4's missiles effectively.[22]



During Vietnam War, Airman fires 20mm cannon at point-blank range from F-105 while passing 15 to 20 feet below MiG, hitting left wing near fuselage as it bursts into flames (U.S. Air Force/National Archives and Records Administration)

Situational Awareness. The Air Force also pursued a technological solution to increase its pilots' situational awareness. The Red Baron study cited earlier concluded that achieving a position of advantage first was the most important determinant of success in air-to-air combat over North Vietnam. Existing efforts to detect MiGs and transmit their locations to U.S. fighters, such as the group of EC-121D airborne radar surveillance aircraft flying orbits over the Gulf of Tonkin, were insufficient due to technical limitations, harsh environmental conditions, and resource constraints. U.S. pilots were being shot down because they were caught unaware. The key requirement was for more timely position information on enemy aircraft. The Air Force assumed that if pilots knew where the MiGs were and could enter engagements from at least a neutral position, they stood a good chance of scoring a victory.[23]

In August 1972, the Air Force began to field a technical solution to the warning problem, an all-source fusion center—called Teaball—located at Nakhon Phanom Air Base in Thailand. Teaball fused signals intelligence, including voice communications between Vietnamese MiG pilots and their ground controllers, with ground- and air-based radar information. It then relayed the location of both U.S. Air Force and enemy aircraft to U.S. pilots over a complicated set of radio nets. Pilots received compass heading, speed, and vector information.[24]

The Navy had been using the radars and signals intelligence capabilities on its ships in the Gulf of Tonkin to improve the situational awareness of its pilots and provide ground-control intercept (GCI) along the coast of Vietnam, a capability it called Red Crown. The SPS-30 radar on the ships proved unreliable, so in early 1967 the Navy upgraded the ships with the more reliable and capable SPS-48 radar. After the upgrade, the Red Crown ships were able to improve substantially the situational awareness of pilots in their coverage areas for the remainder of the war.[25]

Institutional Adaptation

Analysis of the engagements during the first 4 years of aerial combat over Vietnam suggested that U.S. pilots, especially F-4 crews, were not adequately trained for the air-to-air mission. Debriefings of F-4 and F-105 pilots found that most of them felt poorly trained for air-to-air combat. Both the Air Force and the Navy recognized that the air-to-air training for their pilots was insufficient, yet only the Navy took steps to change the training quickly enough to affect aircrews' performance before the end of the war.[26]

Pre-war training in the Air Force did little to prepare pilots for aerial combat. The problem was not, however, the total amount of training, but its focus, quality, and realism. From 1954 to 1962, the Air Force training curriculum for fighter pilots sought to qualify them for both ground attack and air-to-air missions. Training time was divided between the two missions, but the standard 6-month training interval included more than 100 air-to-ground missions and only 6 air-to-air missions.[27]

The quality of Air Force air-to-air training was also poor. Pilots who went through it complained that it was confusing and relied on outdated formations and tactics, such as the Fluid Four. There was little true verbal instruction by flying instructors, who seemed to believe that they had learned the hard way, so their students should too.[28]

Lastly, Air Force air-to-air training was unrealistic, largely because of the heavy emphasis on safety. The Air Force lost 824 aircraft in 1951 and 472 in 1959. Increased emphasis on safety reduced the loss rate to 262 in 1965, and no one wanted the rate to go back up. Consequently, TAC imposed strict limits on aircraft maneuvering and conducted all air-to-air training against similar aircraft.[29]

The Air Force examined proposals to change the training system during the war, but they were not considered feasible. The pressure to get pilots through the pipeline and into combat operations was too great. The Air Force had no spare assets to begin new programs.[30]

In the Navy, the Ault Report also found that F-4 crews lacked the training and tactics to cope with the smaller, more agile North Vietnamese MiGs. The Navy acted quickly to correct the deficiencies in its air-to-air training. The Navy established the FWS, more commonly known as "Top Gun," at Marine Corps Naval Air Station Miramar near San Diego, California, in late 1968. The first class graduated in April 1969. By mid-1972, more than 200 naval aviators had been through Top Gun and returned to the fleet. The syllabus emphasized training against dissimilar aircraft whose size and performance resembled North Vietnamese MiGs. Because the Navy had not adopted a cannon in the F-4, Top Gun training also emphasized employing missiles more effectively, primarily by using the AIM-9 rather than the less reliable AIM-7.[31]

Among the reasons for the Navy's more rapid implementation of improvements to air-to-air combat training was the existence of a community that was already advocating for change. Navy squadrons were divided into fighter and attack squadrons, so fighter squadrons focused on air-to-air training. F-8 pilots, who still had cannons on their airplanes, developed a training program before the war that emphasized dogfighting. Some of those pilots had been sent to "help" Ault with his report. It is thus unsurprising that Ault's report recommended establishing an advanced FWS "as early as possible."[32]

Another part of the changes the Navy implemented was an effort to ensure that Navy GCI controllers had extensive training in controlling fighters in air-to-air combat. The Navy's ship-based Red Crown controllers worked closely with the Top Gun–trained Navy pilots and knew how and when to feed them the information they needed to be effective.[33]

Policy Adaptation

Air Force personnel policies also adversely affected pilot performance. When the air war over Vietnam began in 1965, the average Air Force fighter pilot had more than 500 hours of flying experience in his aircraft type. However, Air Force Chief of Staff Joseph P. McConnell implemented a policy stating that no pilot would be required to do two tours of duty in Southeast Asia until every pilot had done one. Aircrews returned home after one year or 100 missions; less experienced crews replaced them. By June 1968, Air Force fighter pilots facing MiGs over North Vietnam had spent just 240 hours in their aircraft type.[34]

According to several Air Force pilots who served in Vietnam, the Service's pilot rotation policy affected the quality of training. Air Force training bases sought to produce pilots as fast as possible to accommodate the policy goals of no pilot doing two tours until every pilot did one. Standards were lowered as quantity became more important than quality. Most who attended the training regarded it as a poor learning experience that did not adequately prepare them for combat. Some pilots never qualified in some of the events in the training syllabus

North American Rockwell OV-10A "Bronco" Light Armed Reconnaissance Aircraft of U.S. Navy Light Attack Squadron Four (VAL-4) fires Zuni 5-inch Folding-Fin Aircraft Rocket at target somewhere in Mekong Delta, Republic of Vietnam, June 1969 (U.S. Navy/National Archives and Records Administration/A.R. Hill)

but graduated and were sent into combat because the Air Force needed bodies to fill cockpits.[35]

In contrast, Navy aircrews flew 60–70 missions each cruise; a tour of duty in a carrier air wing typically involved several cruises. Experienced pilots rotated continuously through the combat zone. Moreover, the Navy could not lower pilot standards too far because pilots still had to land on a carrier. A relatively small cadre of Navy pilots thus flew the bulk of the missions over North Vietnam and took most of the losses. Although the loss rate remained steady rather than increasing, the losses were distributed among a smaller group of pilots, which caused morale problems.[36]

Evaluation

The resumption of the air war over North Vietnam in 1972 provided an opportunity to assess how well the Air Force and the Navy adapted to the disruption they had experienced from 1965 to 1968. When aerial combat recommenced, the Navy's kill ratio increased dramatically. During the final 13 months of major U.S. combat operations (January 1972 to January 1973), Navy F-4 squadrons shot down 24 MiGs and lost only 2 of their own aircraft for a kill ratio of 12 to 1. Meanwhile, the Air Force kill ratio declined. The Air Force shot down 48 MiGs and lost 24 aircraft to MiGs for a kill ratio of 2 to 1.[37]

There were differences in performance between Air Force and Navy aircrews in 1972–1973, one being a difference in missile performance and usage. The Air Force continued to have missile problems when the air war resumed in 1972. The Sidewinder variant the Air Force developed after the AIM-4D failed, the AIM-9E, actually had fewer kills per missile fired than its predecessor, the AIM-9B. In July 1972, the Air Force rushed another new Sidewinder model, the AIM-9J, into service. Tests indicated it was more maneuverable and had a larger launch envelope than the AIM-9E, but the tests were conducted under highly controlled conditions. The missile performed poorly in actual service. Of the 31 attempted AIM-9J launches from September until the end of December 1972, 23 were misses, 4 were kills, and 4 failed to launch.[38]

Meanwhile, the Navy's replacement for its AIM-9D, the AIM-9G, was even better than its already successful predecessor. The Navy AIM-9G was fired 50 times and had 23 kills for a success rate of 46 percent. The Air Force asked if the AIM-9G could be made available, but it

was found to be incompatible with Air Force launchers and electronics.[39]

The AIM-7 Sparrow continued to be a disappointment for both Services. Two-thirds of the AIM-7s fired by both Services malfunctioned. The Air Force never recognized the ineffectiveness of the AIM-7. An Air Force general who directed Pacific Air Forces operations noted in 1972 that Air Force aircrews felt the AIM-7 was a better missile than the AIM-9. The Air Force used the AIM-7 for 30 of its 48 kills. The Navy, on the other hand, realized by 1968 that the AIM-7 was unreliable. Top Gun instructors urged their students to avoid it in favor of the AIM-9. The Navy used the AIM-9 for 23 of its 24 kills.[40]

The Air Force credits Teaball with substantially reducing its air-to-air losses. From the time Teaball became operational on July 29, 1972, until the end of the war, the U.S. Air Force kill ratio improved to almost 4 to 1. But Teaball did not always work. The biggest problem was the ultra-high-frequency relay that Teaball used to send updates and guidance to U.S. aircraft, which tended to stop working unexpectedly. When Teaball did not work, the Air Force struggled. The Air Force lost six aircraft to MiGs after Teaball was activated; at least three and possibly four of the aircraft were lost when it was not working.[41]

The key difference, however, appears to have been training. Post-war interviews with Air Force F-4 crews showed they thought the first and most important reason for the Navy's higher kill ratio was its aggressive training program. Naval aviators returning from their second combat tour reported that their MiG encounters were "like Top Gun, only these guys weren't half as good."[42]

The experience of U.S. aerial forces in Vietnam eventually contributed to a training revolution. The Navy was so convinced that the dissimilar air combat training at Top Gun was so valuable that it expanded the technique to attack squadrons after the war ended. Although it was too late to affect fighter performance in Vietnam, the Air Force established its first aggressor squadron, the 64th Fighter Weapons Squadron, at Nellis Air Force Base in October 1972. The aggressors initially flew T-38s, which resembled MiG-21s in size and performance, to provide dissimilar training to Air Force fighter units. The initiative for creating the aggressors came from FWS instructors at Nellis.[43]

In 1975, officers in the Air Force's electronic combat directorate—who were aware of research indicating that the majority of combat losses occurred in a pilot's first ten missions—pushed to expand test instrumentation at Nellis and used the test range and aggressor squadrons in a series of rotational training exercises, called Red Flag, for fighter squadrons. The goal was to provide pilots with the experience of their first ten dogfights, thus increasing their odds of surviving and performing well in an actual conflict.[44]

Conclusion

A review of Navy and Air Force efforts to adapt to unexpectedly poor air-to-air performance in Vietnam provides several insights for the current and future joint force regarding who typically drives adaptation, how long it takes, what contributes to success, and what can be done to avoid or minimize future disruptions. The first insight is that the time needed to adapt to disruption depended most significantly on senior leadership. Even with senior leadership's backing, however, adaptation took several years. Recognition that there was some sort of problem came fairly quickly. Within a few months of the start of aerial combat, both the Navy and the Air Force recognized that their air-to-air performance was not living up to expectations.

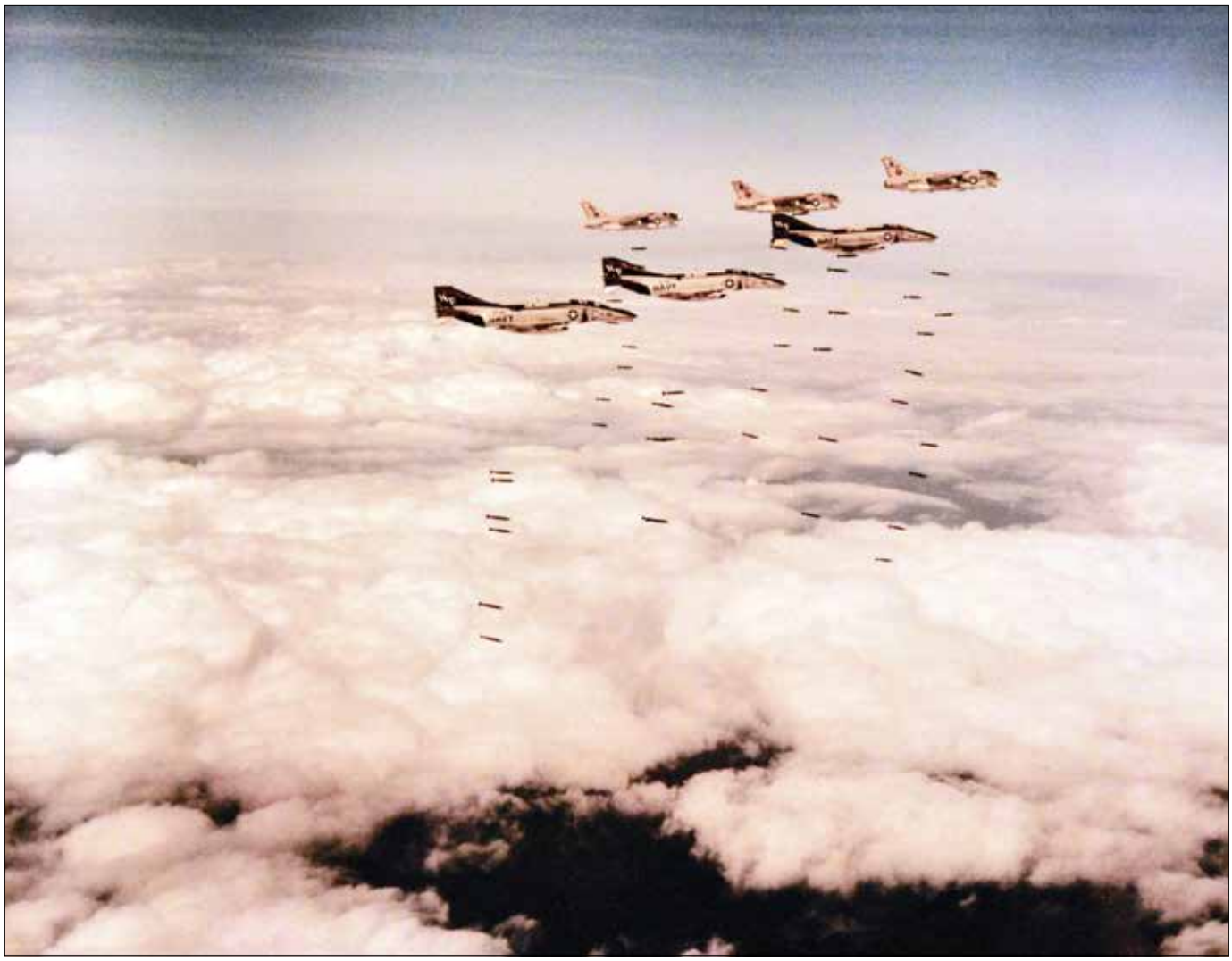
Gaining the requisite understanding of the problem took longer and required initiative from higher level leadership. In 1966, the Director of Defense Research and Engineering initiated the Red Baron studies that collected and analyzed the data on aerial engagements over North Vietnam. The CNO started Project Plan the same year. Initiating a comprehensive study of the problem, the Ault Report, took 2 more years and required the intervention of a newly appointed CNO.

Without the support of senior leadership, adaptation in the Air Force often depended on initiative from field grade officers and took much longer. There were advocates for guns on fighters within the Air Force, for example, but they were typically lone colonels in the distinct minority and had no platform or organization around which to concentrate. Similarly, the key figures in the creation of the aggressors and Red Flag were field grade officers. Criticism within the Air Force of training and tactics during the war was relatively muted after the war because many of the generals who had been responsible were still in high positions within the Air Force. It was not until the late 1970s, when many of the field grade officers from the Vietnam era began to reach higher ranks, that the corporate Air Force felt free to criticize its training during the war.[45]

Once the problem was understood and adaptations were proposed, implementation was relatively quick in both Services. The Ault Report was finished within months of starting in 1968. Top Gun was created late that year, and the first graduates reached the fleet by spring 1969. The first Red Flag took place just 6 months after it was approved by the TAC commander.

The importance of senior leadership to successful adaptation suggests that leadership development will continue to be a crucial element in creating a more adaptive joint force. The inclusion of case studies of successful and unsuccessful adaptation in joint professional military education could better prepare commanders for the cognitive and organizational challenges of adapting under fire.[46]

The second insight is that a broad approach to the problem and changes in more than one area produced more successful adaptation. The Air Force quickly concluded that the problems were largely technical and therefore sought to adapt its technology. The technological changes, including the addition of a gun and other modifications to the F-4 and the development of the Teaball fusion center, improved performance moderately but could not counteract the



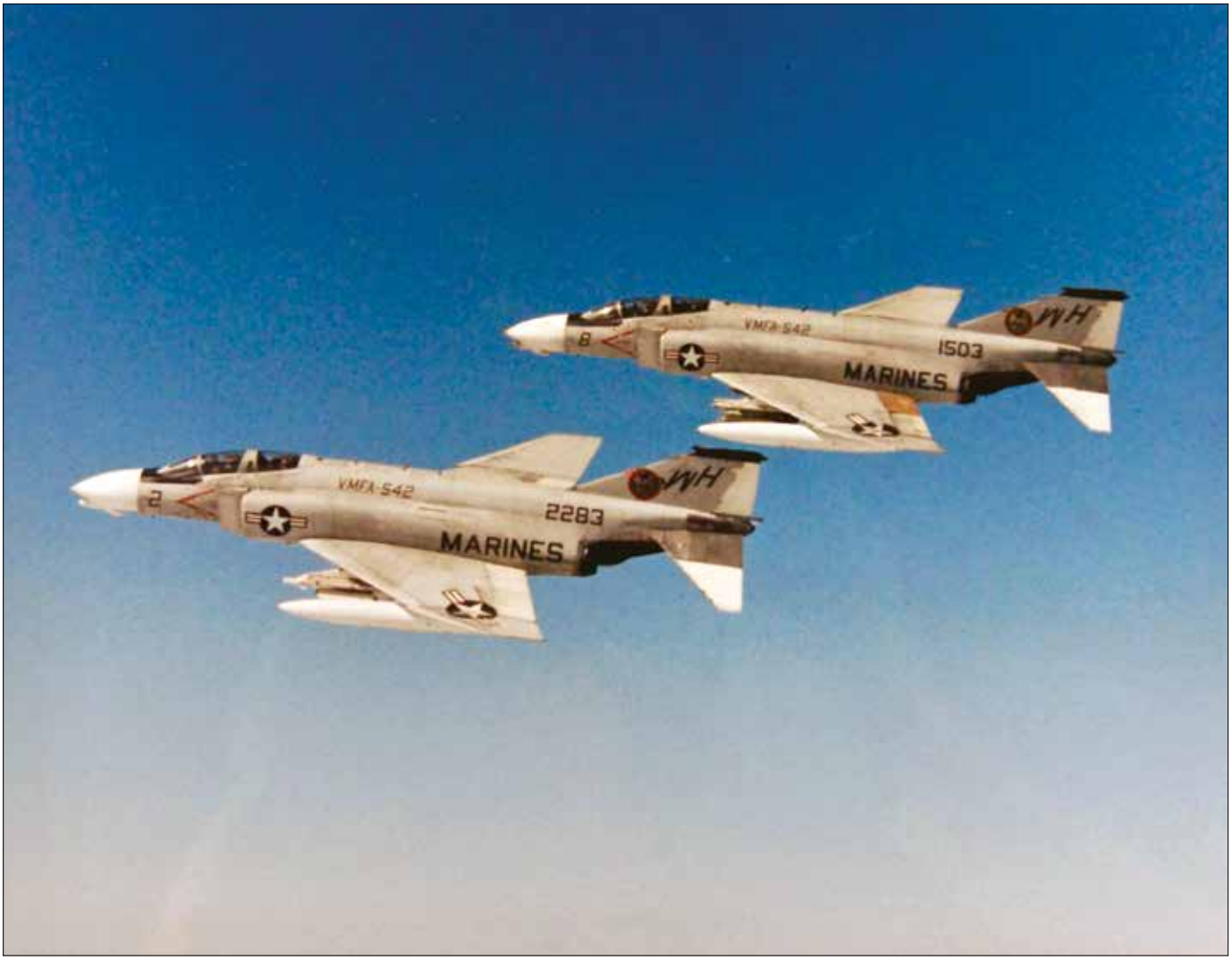
Three fighter squadron 161 Phantom II fighter aircraft from USS *Midway* and three Corsair II attack aircraft from USS *America* drop Loran bombs during strike mission in Vietnam, March 1973 (U.S. Navy/National Archives and Records Administration/Fred P. Leonard)

negative effects of Air Force inaction in other areas, including tactics, training, and personnel policy. By contrast, the Navy changed its tactics by relying less on AIM-7 Sparrow missiles and more on AIM-9 Sidewinders, its technology by improving the naval version of the Sidewinder and, most important, its training by creating Top Gun. The result was a significant improvement in performance.

The third insight is that disregarding alternatives because they were "not invented here" significantly slowed adaptation. The Air Force adhered to outdated fighter tactics throughout the war, in part because the alternative was seen as too closely associated with the Navy. It revived the AIM-4 Falcon, for example, because the AIM-9 Sidewinder was originally a Navy missile. The Air Force also chose to forgo cooperating with the Navy on a new Sidewinder. When neither the Falcon nor the Air Force version of the Sidewinder proved effective, the Air Force's options were limited because its planes were not wired to carry other missiles. The joint force must take advantage of all opportunities to learn and improve its ability to adapt to disruption, no matter which Service originated those ideas.

The fourth insight is that harnessing the expertise coming off the battlefield contributed to successful adaptation. Top Gun worked because the Navy used experienced combat pilots to teach students. The Top Gun instructors conveyed that knowledge to the students and helped them learn how to teach the members of their squadrons when they returned to the fleet. The Navy's success highlights the potential value of joint lessons learned efforts that seek to transmit the knowledge won on the battlefield to the rest of the force.

Navy and Air Force experience with aerial combat during the Vietnam War also suggests some steps that might help avoid or minimize disruption in the future. One step is to consider a broad spectrum of scenarios for future conflict instead of just fixating on one. Even as today's joint force focuses on potential conflicts with peer competitors, it would do well to keep other contests and competitors in mind. Many Air Force and



Two F-4B Phantoms of VMPA-542, U.S. Marine Aircraft Group 11, 1st Marine Aircraft Wing, Da Nang RVN, on way to targets in support of Marines working in Northern "I" Corps, Vietnam, January 1969 (U.S. Marine Corps/National Archives and Records Administration/Carl Erikson)

Navy deficiencies in aerial combat during Vietnam occurred because the Services focused almost exclusively on a potential large-scale conventional and nuclear conflict against the Soviet Union during the late 1950s and early 1960s. Fighters did not need to maneuver or carry guns if they were shooting at slow-moving Soviet bombers with limited maneuverability. Unfortunately, the war in which the Navy and Air Force found themselves was not the one for which they prepared. Lieutenant General William Wallace's observation in 2003 that the irregular Iraqi enemy that U.S. forces were fighting "is different from the one we'd war-gamed against" suggests that the challenges of anticipating future opponents and scenarios persist.[47]

Finally, realistic testing and training that employ challenging situations and capable adversaries may enable military forces to avoid or more quickly adapt to future disruptions. Both the Navy and the Air Force were consistently surprised when their missiles performed poorly, in part because missile testing was often conducted against unchallenging targets under highly controlled conditions. In contrast, the implementation of more realistic, albeit more risky, dissimilar air combat training at Top Gun and, eventually, at Red Flag, significantly improved the ability of U.S. pilots to respond to the unexpected. Current and future joint training must incorporate challenging scenarios, such as operations in degraded information or contested aerospace environments. The U.S. Navy regularly trains to operate in an electronically denied environment where command and control has been heavily impacted, and the U.S. Air Force has explored the implications of a day without space, but the joint force needs to begin developing new tactics, techniques, procedures, and capabilities to ensure coordinated efforts in such scenarios. **JFQ**

Notes

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