GAINING THROUGH TRAINING:
PILOT PROFICIENCY IN MODERN COMBAT AVIATION

BY

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A THESIS PRESENTED TO THE FACULTY OF
THE SCHOOL OF ADVANCED AIR AND SPACE STUDIES
FOR COMPLETION OF GRADUATION REQUIREMENTS

SCHOOL OF ADVANCED AIR AND SPACE STUDIES
AIR UNIVERSITY
MAXWELL AIR FORCE BASE, ALABAMA
JUNE 2016

APPROVAL

The undersigned certify that this thesis meets master's-level standards of research, argumentation, and expression.

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DISCLAIMER

The conclusions and opinions expressed in this document are those of the author. They do not reflect the official position of the US Government, Department of Defense, the United States Air Force, or Air University.

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ACKNOWLEDGMENTS

This work is the product of a team of individuals. I would like to thank my advisor, Col Timothy Cullen, for his wisdom and patience. His mentoring and coaching were invaluable to the research and writing process. I would also like to thank Dr. Stephen Chiabotti and the faculty at the School of Advanced Air and Space Studies for their guidance and insight. Additionally, I express gratitude to Col Charlie Simpson, USAF, retired, and all the members of the Association of Air Force Missileers for their overwhelming cooperation and response to my research questions. Lastly, I would like to thank my family for their unconditional love and support. My beautiful bride and amazing kids are the greatest team to which I will ever belong.

This work is dedicated to the men and women who "fly the line." They execute the mission twenty-four hours a day, seven days a week, keeping my family safe. With much sacrifice and little recognition, the thousands of warriors that maintain, fly, and exploit the MQ-1 and MQ-9 perform their duty with honor and distinction. I am ever grateful for their continued sacrifice.

ABSTRACT

This study provides an analysis of how the US Air Force could improve MQ-9 pilots' decision-making skills in combat. The work first outlines reasons why the RPA community struggles to produce consistently proficient pilots in dynamic combat scenarios. The author then utilizes a historical, qualitative, and conceptual analysis of The Air Mail Fiasco, Arc Light, and Instructional Systems Development in ICBM training to identify contextual parallels to operational training of modern combat aviators. In the 1930s, US Air Corps leadership incorporated short-term policy changes and long-term changes to training, including quantity of training and the use of simulators, to improve pilot proficiency. In the 1960s, Strategic Air Command adapted the combat missions of B-52s in Vietnam in an attempt to make combat scenarios more familiar to bomber aircrew. In the 1970s, missileers changed the training philosophy in their initial qualification unit. Later, when they implemented the same training philosophy at the operational combat units, crew proficiency improved. These case studies demonstrate the ability to improve combat decision-making through focused, scenario-based training to positively affect the battlefield. To improve MQ-9 pilot proficiency, the Air Force needs to provide pilots dedicated training time, away from combat, when they can practice making decisions and witness the associated consequences in realistic scenarios.

CONTENTS

Illustrations

Introduction

Exertions must be practiced, and the mind must be made even more familiar with them than the body. When exceptional efforts are required of him in war, the recruit is apt to think that they result from mistakes, miscalculations, and confusion at the top. In consequence, his morale is doubly depressed. If maneuvers prepare him for exertions, this will not occur.

Carl Von Clausewitz

In 2014, two enemy combatants affiliated with a declared national enemy drove their vehicle through a rural area. Unbeknownst to them, the combatants were under the careful observation of a young MQ-9 Reaper pilot and his even younger sensor operator. The pilot skillfully flew his aircraft and directed the on-board sensors to follow the vehicle carrying two potentially hostile personnel. Meanwhile, experts analyzed information collected from the MQ-9's sensors, as well as information from other sources, and determined the two individuals in the vehicle posed an imminent threat to friendly forces. The vehicle was moving towards allied ground personnel and simultaneously moving out of a zone where the MQ-9 could execute a successful strike, so the ground commander ordered the MQ-9 pilot to destroy the vehicle as quickly as possible.

Although previous training had provided the pilot some knowledge and practice in executing similar attacks, the specifics of this mission made the scenario unique. In the past, the MQ-9 pilot had trained with a formation of multiple aircraft to destroy a moving target. The pilots of each aircraft in the training formations knew their specific roles during the strike. One aircraft would use its sensors to search ahead of the vehicle's path, looking for any other vehicles, personnel, or infrastructure that could be injured or damaged in a strike. Another aircraft would use a targeting laser to guide a missile to the moving vehicle. Assistance from the other two aircraft could provide the shooting pilot situational awareness on what lie ahead in the road as well as a steady laser on the target for the missile to track. This would take multiple tasks away from the pilot shooting the missile so he could focus on employing the weapon with little distraction. On the mentioned mission, however, the ground commander tasked an inexperienced MQ-9 pilot to execute a difficult strike alone, without pre-coordinated assistance from other aircraft.

The pilot subsequently made some poor decisions in striking the vehicle. He rushed through the execution under stress and without good situational awareness. First, he chose not to utilize other nearby assets. The additional aircraft had lower-priority missions and could have quickly assisted the shooting pilot with his task. Second, he failed to use his own aircraft sensors to search ahead of the vehicle and ensure nothing in the vehicle's path would impede employment of a weapon. This is a difficult undertaking, but one the pilot did not even attempt. Failure to clear the path of his intended target turned out to be disastrous. After the pilot released the weapon, a separate vehicle, previously undetected, drove near to the target vehicle's location. Panicked, the pilot turned off the laser guiding the missile to the target vehicle. Fortunately, the missile caused no unintended violence, but the vehicle departed undamaged and the enemy combatants escaped. The mission was a failure.[1]

This is not an isolated incident, and the multi-role remotely piloted aircraft (RPA) community has witnessed other pilot-proficiency issues. An unacceptable percentage of MQ-9 pilots make poor decisions in stressful, dynamic combat situations. The consequences of poor decisions can be severe as RPA pilots often fly in sensitive areas and receive taskings to strike important targets with potential to kill innocent people. The resulting international backlash from certain poor decisions is grave. Why are Reaper pilots not better at combat decision-making? How can operational MQ-9 pilot training create pilots capable of making better decisions? What can policy makers do to increase MQ-9 pilot proficiency in all their assigned missions?

Development of the MQ-9 Reaper

The proficiency problem among MQ-9 pilots has developed over time. The way in which the USAF acquired the MQ-1 Predator and MQ-9 Reaper, the growth rate of the community, the exigencies of current combat operations, and the training processes are all contributing factors to a lack of pilot proficiency. If unchecked, the problem could negatively affect military operations throughout the world, because MQ-9 pilots participate in missions where poor decisions could result in negative strategic consequences.

[1] The author witnessed a de-brief of this incident.

The USAF acquired the MQ-9 in a rushed process that led to a less-than-optimal cockpit design. General Atomics, producer of both the MQ-1 and the MQ-9, created the MQ-9 as an independent research and development program. With internal initiative, engineering expertise, and their own resources, General Atomics designed and created the Predator and the Reaper. The Air Force did not have direct input into aircraft requirements or specifications similar to the process in most major acquisitions. The lack of USAF input is evident in the cockpit design and human-machine interface. When General Atomics engineers first designed the MQ-1 and MQ-9 cockpit, their intent was not to employ the aircraft as a weapon system but to demonstrate the system could stay airborne for long periods of time.[2] The events of 11 September 2001 and the subsequent operations in Afghanistan instigated a very quick acquisition, development, and test process to use the capability for weapons employment as well as enduring observation of targets. In 2003, just one year after developing a concept of operations, the Air Force completed prototype testing of the Reaper.[3] The original plan called for aircraft production to begin in 2007, "but the Secretary of the Air Force and the Secretary of Defense pushed for the accelerated development of Reaper in 2004 because of the expanding Global war on Terrorism."[4] The USAF purchased the aircraft and software "as is" and just like the MQ-1, the atypical interface forced pilots to adapt, accept abnormal procedures as standard operations, and learn entirely new habit patterns to fly the aircraft.[5] Processes that took one switch actuation in a traditional cockpit took

[2] Timothy M. Cullen, "The MQ-9 Reaper Remotely Piloted Aircraft: Humans and Machines in Action" (PhD Diss., Massachusetts Institute of Technology, Cambridge, Massachusetts, September 2011), 285.
[3] Cullen, "The MQ-9 Reaper Remotely Piloted Aircraft: Humans and Machines in Action," 261.
[4] Cullen, "The MQ-9 Reaper Remotely Piloted Aircraft: Humans and Machines in Action," 262.
[5] The opinion of a poorly designed MQ-9 cockpit is based on the author's personal experiences in both manned and remotely piloted aviation, as well as numerous interviews with USAF MQ-1 and MQ-9 pilots, Big Safari test pilots, and General Atomics pilots and employees. Since initial MQ-9 production, several aviation companies have designed and produced prototypes of cockpits for multi-role RPAs that more closely resemble a traditional aviation cockpit. These cockpits do not require two keyboards, eight monitors, two mice, and a throttle and stick to maintain situational awareness and fly the aircraft.

several steps to accomplish in the MQ-9, and the aircraft controls have remained relatively constant since 2004. The responses from interviews of 50 MQ-9 pilots in 2009 communicate the awkwardness of the human-machine interface. Pilots described flying the aircraft and interpreting morphing characters of data as if they were flying “the matrix,” referencing the Hollywood film portraying an extremely complex reality.[6] The MQ-9’s cockpit design does not contribute to good decision-making because the pilot spends more effort to read the aircraft and sensor instruments, perform routine tasks, and fly the aircraft than a pilot would in an occupied aircraft.

In the last fifteen years, no other aircraft community has grown faster than the MQ-9. In 2015, the USAF trained 280 new MQ-1 and MQ-9 pilots. In 2016, the USAF will train 449 new MQ-1 and MQ-9 pilots, a 60% increase in students.[7] Immediately after initial-qualification training in their respective aircraft, RPA pilots will fly and support Combat Air Patrols (CAP) over Afghanistan, Iraq, Syria, Africa, and other parts of the world. Each CAP signifies one aircraft airborne, on an assigned mission, for up to 24 hours. In 2008, the USAF flew 33 CAPs worldwide. On 28 May 2014, the CAP number reached 65, a growth rate of almost 100% (see Table 1).[8]

Current RPA manning levels provide enough pilots to fly the combat air patrols and not accomplish much else. For many squadrons, just keeping the combat missions manned with qualified pilots is a struggle.[9] Dedicated training time is difficult to schedule when all the available pilots and instructor pilots are flying combat sorties. General Carlisle, Commander of Air Combat Command, told a March 16 hearing of the

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[6] Cullen, “The MQ-9 Reaper Remotely Piloted Aircraft: Humans and Machines in Action,” 46.

[7] Colonel Rob Kiebler, 49 WG/CC, “RPA Strategic Vision,” PowerPoint Briefing, 28 September 2015, Slide 4.

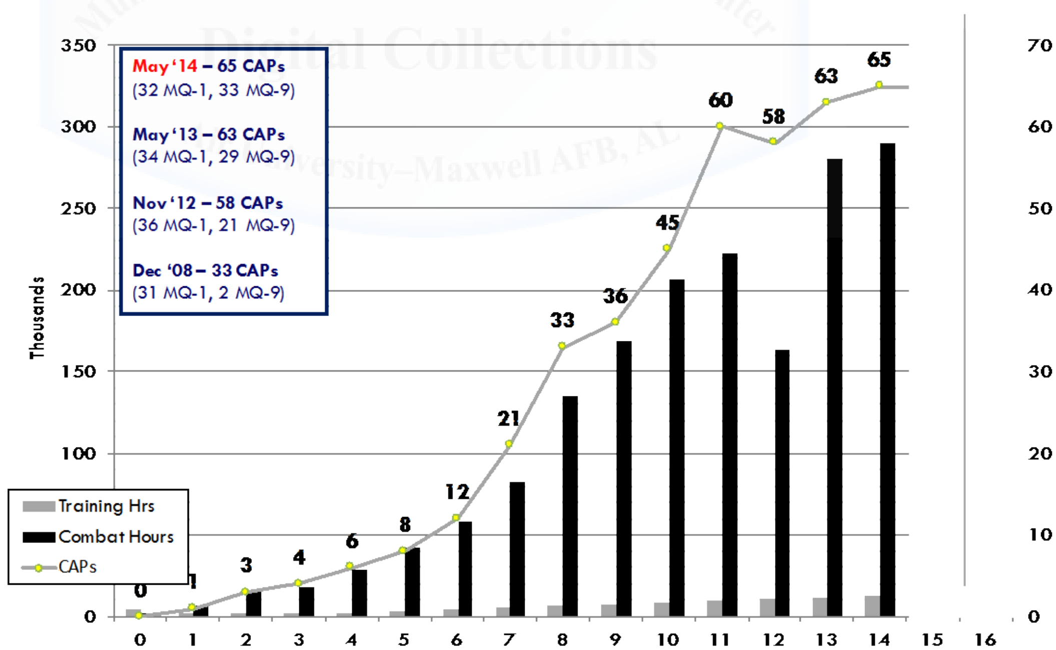
[8] Staff Sgt. Adawn Kelsey, “RPA Community Launches 65th Combat Air Patrol,” USAF News, 9 June 2014, retrieved on 22 February 2016 from http://www.af.mil/News/ArticleDisplay/tabid/223/Article/485358/rpa-community-launches-65th-combat-air-patrol.aspx.

[9] Unattributed interview with an RPA Squadron Commander, 9 December 2015.

Senate Armed Services subcommittee, "There's no other part of the Air Force that has 100 percent of their aircrew, their capability engaged 100 percent of the time."[10]

Continuous engagement in combat has severely hampered the ability of instructor pilots to train less-experienced pilots. Operational training in a combat squadron requires two pilots—the student pilot and the instructor pilot. Choosing to spend time training requires two qualified personnel that could be flying two separate combat sorties. A dedicated training flight also requires an aircraft, a cockpit, maintenance time and personnel, and dedicated satellite time to communicate between aircraft and cockpit. The cost in both time and money is significant. Table 1 shows that MQ-1s and MQ-9s flew almost 300,000 combat hours last year but logged less than 10,000 training hours. Nearly all of the training hours occurred at the training base where brand new RPA pilots learn to fly the MQ-1 and MQ-9. Combat RPA squadrons spend minimal time training; and after their initial aircraft training, MQ-9 pilots receive very little continuation training because demand for the aircraft has grown faster than the supply of qualified pilots.

Table 1: MQ-1/9 CAP Growth, Combat Hours, and Training Hours



Source: "RPA Strategic Vision" Briefing

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[10] Phillip Swarts, "Wanted: A Few Good Drone Pilots," Air Force Times, 21 March 2016, http://www.airforcetimes.com/story/military/2016/03/21/career-rpa-pilot-job-drone/81883080/.

The USAF has tried multiple methods to acquire and train RPA pilots. When the RPA program first began, the USAF drew the small cadre of MQ-1 pilots from other types of aircraft. Many of these experienced aviators completed a three-to-four-year tour flying MQ-1s and then returned to their previous platforms. Others remained MQ-1 pilots. As the RPA community grew, the Air Force continued to supply RPA pilot demands from other aircraft. As demands to fill RPA cockpits outpaced the ability to draw from traditional platforms, the USAF transitioned direct graduates from pilot training to fly MQ-1s and MQ-9s. This temporary fix was unsustainable, however, because other aircraft also needed the pilot-training graduates to fill vacant cockpits. In an effort to increase RPA-pilot manning at a reduced cost in both time and funds, USAF leadership announced a tailored pilot training program for RPA pilots, separate from the traditional pilot training program for occupied aircraft.[11] The model of pulling pilots from other platforms and using newly graduated pilots from pilot training did not keep pace with the increased demand for RPA pilots.

Operational necessity forced the Air Force to develop a minimalist training program to produce RPA pilots as quickly as possible for a very specific fight—counterinsurgency. In September 2008, the Chief of Staff of the Air Force (CSAF) gave direction to initiate an undergraduate RPA pilot training program. After 52 candidates and 5 classes, the CSAF directed "normalization" of the program.[12] The first class began in August 2010 and the program, known as Undergraduate RPA Training (URT), continues today. URT has become the primary source of RPA pilots and continues to grow, but the program still lags the needs of combat squadrons.

A historical lack of qualified pilots created a systemic lack of operational training in MQ-9 combat squadrons. Pilots in undermanned combat squadrons have little opportunity to refresh their skills, practice scenario-based training, or receive feedback on their performance from qualified instructor pilots. In addition to low staffing, the exigencies of current combat operations impede quality operational training. The USAF

[11] United States Air Force Press Release, "Air Force Officials Announce Remotely Piloted Aircraft Pilot Training Pipeline," US Federal News Service, 10 Jun 2010.
[12] Major Nate Totten, "AETC Undergraduate RPA Training Deep Dive," PowerPoint Briefing, Headquarters AETC, Aug 2015.

tasks an MQ-9 pilot to fly a combat mission almost every day. Most current combat operations require pilots to collect information on targets. For example, pilots position the aircraft to watch for personnel and "patterns of life."[13] Sometimes the MQ-9's mission is to follow vehicles or search for nefarious activity in designated zones. MQ-9 pilots also work with friendly forces and serve as the "eyes in the sky" to protect ground parties. Over time, pilots become very proficient in positioning an aircraft to collect information, and their communications with the ground parties become more clear and concise because they execute those missions regularly. As we might expect, MQ-9 pilots become proficient at the missions they execute on a regular basis.

When the mission changes to a scenario the pilots have not experienced on a regular basis, however, MQ-9 pilots often struggle to make the proper decisions in the new situation. These dynamic scenarios include times when the enemy behaves in ways pilots do not expect. Because of low staffing and the need to fly the assigned missions, the only regular training pilots receive is on-the-job training resulting from every-day operations. When the assigned mission becomes other than the routine—collecting intelligence on a static target, searching designated zones, following vehicles, or providing protection for friendly forces—pilots often struggle. Standard routines and habits may not promote good decision-making on less-than-familiar missions. Moreover, the community rarely conducts operational training on other than routine missions.

Compare a fighter squadron to an MQ-9 squadron. The daily job of a fighter pilot is to train for potential combat.[14] The USAF expects fighter pilots to be proficient in different mission sets and to fight a dynamic enemy. Through simulators, live training, continued academics, extensive mission briefs before training events, mission debriefs post events, and extended study, fighter pilots train for future conflict. Training provides opportunities to see different scenarios, witness different adversary reactions, fail, and

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[13] "Pattern of life" is a commonly used term describing a form of intelligence collection on a target. If performing an intelligence collecting mission, an MQ-9 pilot will use his aircraft and sensors to continuously monitor a target over long periods of time. The information gathered during this mission creates a target "pattern of life" used for identification, further information gathering, or kinetically striking the target.

[14] The author flew F-16 fighter aircraft for three years before flying MQ-9s

then learn from failure. Pilots learn from their own poor decisions as well as poor decisions of their wingmen. Experienced instructors spend time with less experienced pilots to help identify weak areas and make them more proficient. After training for months at a home station, fighter squadrons deploy to execute the mission. Once the mission is complete, the squadron re-deploys back to a home station where they once again return to training on a daily basis.

Finally, a problem in decision-making in the MQ-9 community exists because of how the Air Force employs the aircraft. In the mobility community, inexperienced co-pilots fly with an experienced aircraft commander. In the fighter community, inexperienced wingmen fly with an experienced flight-lead. In both the mobility and fighter communities inexperienced pilots rarely fly alone without a more seasoned aviator to offset the younger pilot's lack of proficiency. In the case of either the flight-lead or aircraft commander, it is the more experienced pilot that makes decisions for the flight or aircraft. The MQ-9 pilot, however, has neither a flight-lead nor an experienced aircraft commander to rely on for decision-making. Reaper pilots are the most experienced pilots attached to their aircraft and from the very first combat mission MQ-9 pilots fly, they are responsible for all decisions concerning their aircraft.

Despite the fact that they receive very little dedicated training time, squadrons do the best they can to increase pilot proficiency. The initial MQ-9 qualification training provides "aircrew members the training necessary to initially qualify in a basic aircraft position and flying duties without regard to any specific unit's mission."[15] A pilot graduates from the initial qualification course proficient in flying the aircraft and operating its systems, including its weapons and sensors. It is up to the operational combat squadrons to increase pilot proficiency to a point where the pilot can fly actual missions. The combat squadrons do this through a combination of ground and flying training. The intent of their training is to provide pilots and other members of MQ-9 crews "the advanced training necessary to qualify in an assigned aircrew position to perform the missions assigned to a specific unit."[16] Once this mission-qualification

[15] Air Force Instruction (AFI) 11-2MQ-1&9, Volume 1, *Flying Operations: MQ-1&9 Aircrew Training,* 23 April 2015, 8.
[16] AFI 11-2MQ-1&9, 8.

training is complete, however, it may be years before the pilot receives any more dedicated flying training time with a qualified instructor pilot.

Combat RPA squadrons have training plans that attempt to maintain proficiency, but not necessarily to increase proficiency. The Air Force requires pilots to fill out Training Accomplishment Reports after every sortie. On the report, pilots annotate what they accomplished to ensure they maintain currency in certain mission types and mission events. For example, if a pilot followed a moving vehicle during her mission that day, she would check a square for "MVG Target Track."[17] The activity report can have up to six different mission types and dozens of mission events. Because MQ-9 pilots fly one or two mission types every day, maintaining currency in the four or five other mission sets is impossible without dedicated training time. Pilots often find fifteen minutes while transiting back to base or between target assignments, when they can simulate a certain mission set or simulate weapons employment.[18] They accomplish these events, however, by themselves, pretending to be other players in a fictional scenario. The training is better than no training but lacks significant quality compared to dedicated training time with a qualified instructor who can build a realistic and challenging mission scenario. Pilots in combat squadrons rarely get quality training in mission types or scenarios. They train to events, rather than scenarios. In addition, the training events rarely receive feedback from an instructor. No experienced pilot is present to show the less experienced pilot how to improve or techniques that might help in proficiency.

Training also takes place in the simulator, but with limited effect. Pilots can log many training events in either the aircraft or a simulator, and MQ-9 simulator quality has improved over the last five years. The simulators, however, still lack the fidelity to realistically train and improve pilot proficiency in all types of missions. The simulators are excellent for practicing aircraft emergency procedures, basic weapons deliveries, and

[17] Information collected from an unattributed Squadron Training Accomplishment Report, 25 February 2016.
[18] Unattributed interviews with MQ-9 instructor pilots and the author's personal experience.

aircraft positioning. Without greater simulator fidelity and involved scenarios, however, improving pilot proficiency in some aircraft missions is difficult.[19]

Furthermore, the inadequate number of qualified pilots that limit training in the aircraft also limit training in the simulators. The 432d Wing, the largest RPA wing, maintains seven simulators to train 493 pilots, or 70 share a single simulator to stay proficient in their combat missions. In addition to using the simulators to produce proficiency in mission events, the USAF requires each pilot to practice emergency-procedures training in a simulator on a monthly basis, but rarely is an instructor pilot available to develop a scenario and provide instruction. Training in the simulator is much like ad-hoc training in the aircraft. Pilots accomplish individual events to fill out the training-activity report but rarely train to realistic and complex scenarios. Poor simulator fidelity, lack of time, and limited instructor availability prevent quality proficiency training.

MQ-9 pilot-proficiency problems are not attributable to a single policy, resource, or organization. The poor human-machine interface of the MQ-9 cockpit, the extreme growth rate of the RPA enterprise, the exigencies of current combat operations, and the training policies and resources all contribute to pilot-proficiency issues. Reaper pilots are concerned and aware of the issues and seek ad-hoc opportunities to accomplish training events whenever possible to improve and develop their combat proficiency, but not to the extent required.[20] RPA pilots perform an important function in the nation's defense and their decisions can affect global operations for both good and bad.

Creating Proficient Pilots for War

The purpose of this paper is to provide policy makers potential ways to create more proficient MQ-9 pilots. Given resource limitations and understanding the true history of the MQ-1 and MQ-9 programs, how can the USAF improve decision-making capability of RPA pilots? What program, organizational, mechanical, or systemic changes will create MQ-9 pilots with higher situational awareness and capable of better

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[19] Unattributed interviews with MQ-9 instructor pilots and the author's personal experience.

[20] Unattributed interviews with MQ-9 instructor pilots and the author's personal experience.

decision-making in war? The goal is to positively affect Air Force policies with respect to the training of RPA pilots. To that end, the audience includes both civilian and defense personnel who control or influence such policies.

MQ-9 Reapers play an instrumental role in gathering information on the enemy and eliminating national threats, sometimes as directed by National Command Authorities. Situational awareness and weapon precision are more important than ever on today's battlefield, and the MQ-9 brings unique capabilities that enhance both. RPAs have played an important role in providing information to leadership and the flexibility to strike targets in Afghanistan, Iraq, Libya, Yemen, Africa, Syria, and other parts of the world. In 2009, multi-role RPAs employed 197 weapons in combat. In 2015, the number of missiles and bombs striking targets from MQ-1s and MQ-9s grew to 1880, a 954% increase in weapons employment from 2009.[21] The USAF employed more weapons from Predators and Reapers in Afghanistan during 2015 than it did from occupied aircraft.[22] Military and political leaders have become more comfortable with the use of MQ-9s to strike highly visible and sensitive targets.

The problem of MQ-9 pilot proficiency should be disconcerting to policy makers. While an aircraft flown by a proficient pilot brings positive effects to the battlefield, an incorrect decision can also bring strategically negative consequences. Many of the nation's contemporary conflicts require a great deal of restraint and precision on the part of its combat aviators. Some operations could suffer condemnation from the international community if an errant missile or bomb destroys the wrong target or produces civilian casualties. A laser in the wrong spot has the potential to cause much more harm than the good from a laser in the correct spot. The likelihood of future operations that require the capabilities of an MQ-9 is high, and pilots need to be proficient at whatever mission the USAF asks them to execute. MQ-9 pilots need to have high situational awareness and make sound decisions in war.

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21 432d AEW Knee Board. Produced by 432d AEW. December 2015.
22 Josh Smith, "Exclusive: Afghan Drone War – Data Show Unmanned Flights Dominated Air Campaign," Reuters, 20 April 2016, http://www.reuters.com/article/us-afghanistan-drones-exclusive-idUSKCN0XH2UZ.

Pilot Training and Decision-Making

There is nothing new or groundbreaking in the discussion of training pilots. The United States military began training pilots in 1909, when Wilbur Wright patiently taught Lieutenants Frank Purdy Lahm and Frederic E. Humphreys.[23] Without question, many of the training ideas and techniques Wilbur Wright employed in 1909 have changed in the last century. It is also true, however, that the fundamentals of flight and piloting a heavier-than-air object hurtling through the air, have not changed.

Much of the same knowledge, pilot skills, and airmanship required of Lieutenants Lahm and Humphreys to fly their airplane, Signal Corps No. 1, are required of young airmen challenged to fly aircraft today. The Air Force has evolved its methods to train pilots, however, as aerial combat has become more technical and the human-machine interface has become more sophisticated. In his book *Clashes*, Marshall L. Michel III discusses how the USAF created Red Flag and implemented scenario-based training in lieu of event-based training after substandard performance in the Vietnam War. His description of the air war in North Vietnam highlights how human-machine interfaces can enhance or degrade pilot proficiency. For example, the F-4's air-to-air missile displays were inaccurate, leading to many poor weapon-employment decisions and poor kill ratios.[24] Pilots of inhabited and remotely piloted aircraft use cockpit displays to fly their aircraft and to employ its weapons and sensors. The fundamentals of training pilots to fly inhabited aircraft and make stressful, critical decisions equally apply to training pilots to fly remotely piloted aircraft.

An important aspect of piloting an aircraft is decision-making, and an analysis of ways to improve pilot proficiency should include an analysis of decision-making as well. Pilots weigh factors such as weather, threats, geography, time of day, fuel, target locations, friendly assets, aircraft position, weapon selection, atmospherics, aircraft de-confliction, sensor use, and many minute details required to meet the sortie's objective. Many of the decisions a pilot makes while airborne occur under time constraints, and

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[23] Rebecca Hancock Cameron, *Training to Fly: Military Flight Training 1907-1945,* (Air Force History and Museums Program, 1999), 7.

[24] Marshall L. Michel III, *Clashes: Air Combat over North Vietnam, 1965-1972, (*Annapolis, MD: Naval Institute Press, 1997).

proper decision-making is a large factor in pilot proficiency. In order to be a skilled or competent combat aviator, pilots need to make many correct decisions, often in stressful situations. This paper focuses on an RPA pilot's decision-making capacity and how the USAF might improve that ability.

Experts of cognitive science have accepted Naturalistic Decision Making (NDM) as a framework for decision-making. It has been the paradigm used by many psychologists for the last three decades.[25] The paradigm began in the mid-1980s in a study by the US Army Research Institute where psychologists analyzed decision-making in "time-pressured, high-risk settings."[26] The research project used professional urban and forest firefighters to analyze how humans make decisions. The study found that the firefighters, rather than evaluating options to arrive at a decision, relied instead on a perceptual pattern to determine their actions. The firefighters described it as a "sixth sense," but the cognitive experts believed the decisions resulted from a reliance on such things as smoke color or the feel of a "spongy" roof.[27]

Within NDM is a model known as "recognition-primed decision making," or RPD. Researchers found that in time-critical decisions, those made "within less than one minute from the time that important cues or information became available," a good decision-maker does not evaluate options but instead evaluates situations and familiarity. The individual selects a course of action without "conscious deliberation and evaluation of alternatives."[28] In other words, under time constraints, experts rarely consider more than one option. Instead, experts rely on their situational awareness and an understanding of the causal dynamics associated with a decision in order to arrive at a single, promising course of action. Rather than run multiple courses of action through their mind, weigh the consequences of each action, and then compare the results, good decision-makers simply jump straight to the *right* answer. They accomplish this by "mentally simulating a course of action" in projecting "the current situation forward in time and imagine how a

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[25] Robert R. Hoffman and Laura G. Militello, *Perspectives on Cognitive Task Analysis: Historical Origins and Modern Communities of Practice,* (New York, NY: Psychology Press, 2009), 171.
[26] Hoffman and Militello, 172.
[27] Hoffman and Militello, 172.
[28] Hoffman and Militello, 190.

course of action would be carried out in the context of the current and projected situation."[29] If the mental simulation concludes that the course of action does not achieve the desired end, pilots run another simulation until the projected end-state is acceptable. Then they execute the decision.

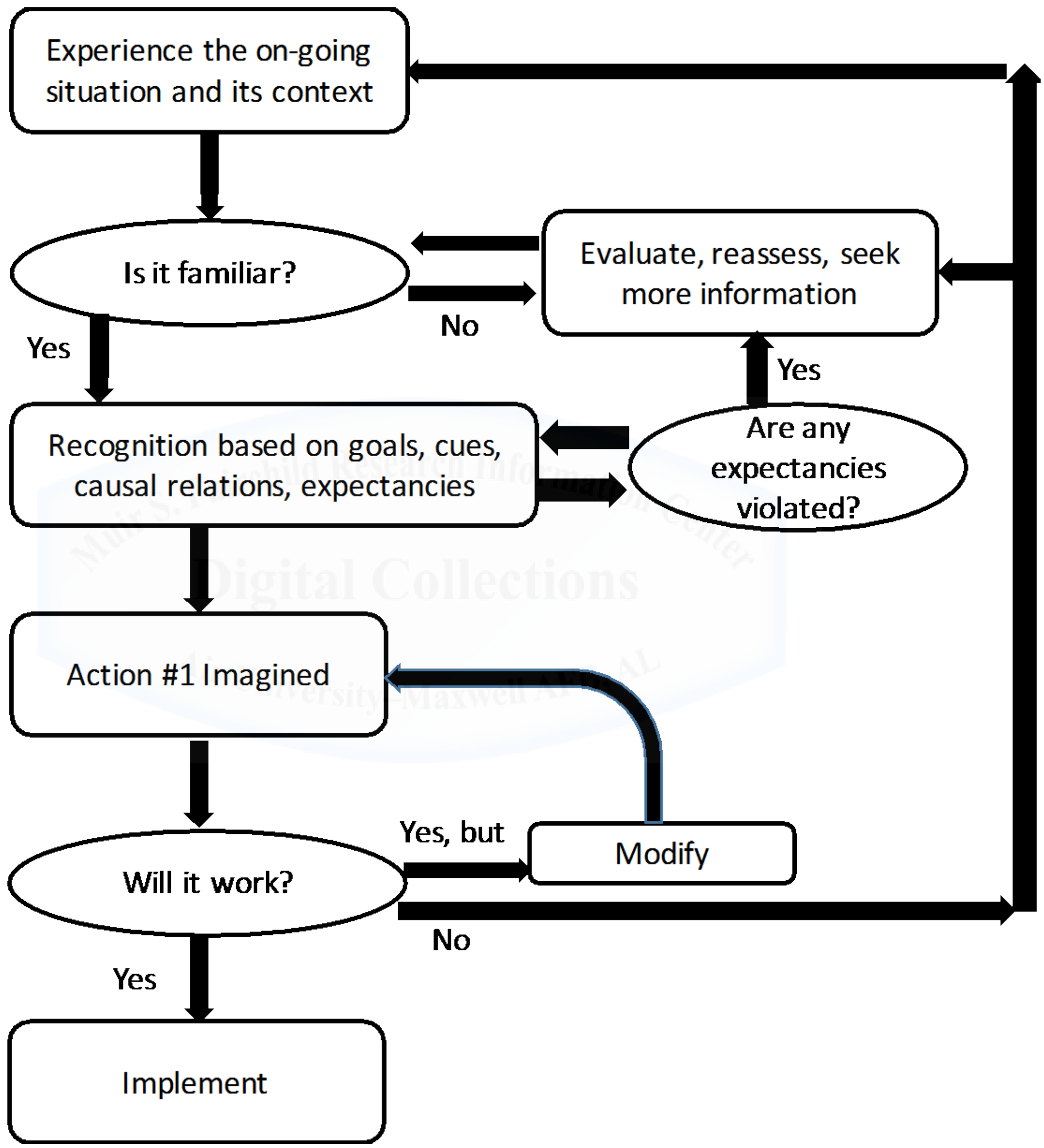

Figure 1. Recognition-Primed Decision Making
Source: Adapted from Hoffman and Militello, Perspectives on Cognitive Task Analysis, 194.

[29] Gary Klein, "How Can We Train Pilots to Make Better Decision?" in *Aircrew Training and Assessment,* ed. Harold F. O'Neil, Jr. and Dee H. Andrews (Mahwah, NJ: Lawrence Erlbaum Associates, 2000), 173.

The RPD model has direct correlation to training pilots. RPD disproves the common conception that pilots make decisions by considering a range of options. Contrary to popular belief, when presented with a stressful, time-constrained decision, pilots do not weigh the consequences of all possible courses of action to determine the best option. Instead, pilots make decisions by mentally projecting a single course of action forward to a logical conclusion. The pilot selects the imagined action based on recognition of the scenario and the pilot's own experience in goals, cues, causal relations, and expectancies. Rather than weighing the consequences of multiple courses of action, the pilot simply makes a decision based on recognition of the scenario and familiarity with the outcome. If skilled decision makers use their situational awareness and experience to generate an effective course of action as the first one they consider, then the focus on producing better decision makers revolves around creating better situational awareness and gaining more experience to understand goals, cues, causal relations, and expectancies.

The model does not discount all decisions based on rational-choice comparison. For example, if a malfunction requires an airplane to divert and land at a previously un-planned airport, the pilot will consider and weigh which airports are viable. However, the RPD model explains why a pilot may disregard some of the airport options automatically. With situational awareness and experience, the pilot knows some of the airfields are not rational courses of action.[30]

Academic work in the field of RPA pilot proficiency and decision-making is limited. At the time of writing this paper, no academic work acknowledged or addressed the specific topic of improving RPA pilot proficiency. Most works concerning RPAs focus on the machine. Colonel Timothy Cullen's PhD Dissertation presents a descriptive ethnographic and historical analysis of MQ-9 air operations, addressing both man and machine, but does not offer prescription to improve the training of RPA pilots. This study seeks to fill the important academic void of RPA pilot proficiency and potential ways to improve performance of combat aviators and the weapon system in war.

[30] Klein, 172.

Definitions

To fully understand the problem, RPA pilot decision-making, and the methodology for this paper, several terms need further definition. First, what is situational awareness? Situational awareness within the study of human factors, like decision-making, has followed an upward trend in research and writing since the 1980s. Psychologists and researchers in human performance recognize situational awareness as an important precursor to decision making. Most simply put, *situational awareness* is knowing what is going on around you. In the case of an RPA pilot, situational awareness also includes knowing what is going on at another location, around the actual geographic location of the aircraft. Situational awareness also has a temporal component. A pilot can have situational awareness one minute and not understand the surrounding environment the next. Mica Endsley defines situational awareness as, “the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future.”[31] Recognition-primed decision-making assumes the pilot recognizes the elements in the environment and comprehends their meaning. Training, experience, and the machine all have potential to enhance situational awareness.

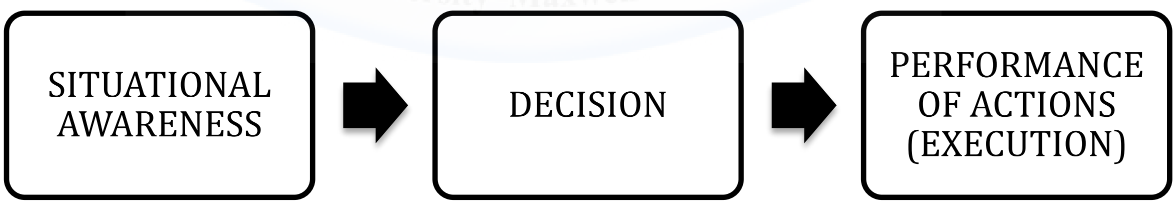

Figure 2. Model of Situational Awareness in Dynamic Decision Making
Source: Adapted from Endsley, Theoretical Underpinnings of Situation Awareness: A Critical Review

Second, *proficient* MQ-9 pilots are those who are skilled at their profession. They use all the necessary and given resources, including a multi-role remotely piloted aircraft,

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[31] Mica R. Endsley, “Theoretical Underpinning of Situational Awareness: A Critical Review” in *Situation Awareness: Analysis and Measurement,* ed. Mica R. Endsley, and Daniel J. Garland (Mahwah, NJ: Lawrence Erlbaum Associates, 2000), 5.

to accomplish the given objective. Situational awareness, decision-making, and execution together make pilot proficiency. In searching for ways to improve proficiency, this paper focuses on decision-making but does not neglect situational awareness because good decisions depend on understanding the context of the environment. A proficient pilot is one who maintains situational awareness, makes good decisions, and effectively performs the selected course of action to achieve the desired goal.

Situational awareness and decision-making include both humans and machines interacting together within an interdependent system. Failures in situational awareness may be the result of shortcomings in the interactions among humans and machines within the weapon system as much as they may be the result of problems in cognitive processes. Problems in cognitive processes are not the only contributing factor to poor decision-making, because the entire war-fighting system includes the machine, the human, and the interaction between the machine and the human. Any component of the interdependent system could contribute to or detract from pilot proficiency.

Training also needs further definition of its subcomponents. *Initial qualification training* refers to the instruction given to students who are brand new to an aircraft or other weapon system. These students are not combat qualified but striving to achieve that goal. Undergraduate RPA Training (URT) and the follow-on MQ-9 formal training unit are the initial qualification courses for RPA pilots. Once they graduate from URT and the MQ-9 initial course, pilots are combat-qualified and then report to operational combat squadrons. Different from initial qualification, *continuation training* (CT) is instruction provided to pilots or crewmembers already combat-qualified. These pilots seek to maintain or improve their proficiency in war through continuation training. Combat crews typically receive this instruction on a regular basis, and the operational squadrons hold the responsibility to provide CT.

Methodology

The methodology of this paper is a historical, qualitative, and conceptual analysis of operator training in military environments analogous to the environments of contemporary RPAs. The work includes an analysis of three case studies: the Air Mail Fiasco of 1934, use of B-52s in Vietnam in Arc Light, and the evolution of training among Intercontinental Ballistic Missile (ICBM) crews in the 1970s. The case studies provide examples of both success and failure in how organizations sought to improve war-fighter situational awareness and decision-making skills. All three case studies contain direct contextual parallels to MQ-9 pilots.

Research for the Air Mail Fiasco case study includes four historical books.[32] The history demonstrates a highly visible failure in pilot proficiency with the machine and the human-machine interface. The failure involved pilot decision-making while flying in the weather and at night without external aircraft references. The winter of 1934 forced pilots to rely on internal cockpit instruments to gain situational awareness and make decisions in order to accomplish the task of mail delivery. Similarly, MQ-9 pilots completely rely on their cockpit for situational awareness and decision-making. The Air Mail Fiasco is a contextual parallel to flying an aircraft remotely because darkness and bad weather forced Air Corps pilots to rely on data provided inside the cockpit to build situational awareness and make decisions. After a publicized catastrophe, the US Air Corps recognized a need to improve pilot proficiency with regard to the human-machine interaction, and the organization used machines as a training tool to improve proficiency.

The second case study, Arc Light, presents a scenario that resembles the prescriptive and controlled employment of the MQ-9. Four primary and two secondary sources comprise the research for the Arc Light history.[33] In the 1960s, B-52 warriors trained for a very important, skilled, and disciplined nuclear fight. They were very proficient at the pre-planned and scripted mission, but when the war in Vietnam required them to make decisions in a more flexible environment, B-52 aircrew were not as

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[32] Norman Borden Jr, *Air Mail Emergency 1934*; Carroll V. Glines, *The Saga of the Air Mail;* Lloyd L. Kelly, *The Pilot Maker;* and Rebecca Hancock Cameron, *Training to Fly: Military Flight Training, 1907-1945.*

[33] Gen Alvan C. Gillem II, transcript of oral history interview by Lt Col Arthur W. McCants Jr. and Maj Scottie S. Thompson; Dale R. Funk, “Study of the Use of B-52 Bombers in War in Vietnam”; Don Harten, *Collision Over Vietnam: A Fighter Pilot’s Story of Surviving the Arc Light;* William P. Head, “War From Above the Clouds: B-52 Operations During the Second Indochina War and the Effects of the Air War on Theory and Doctrine”; Operations Analysis Office, Vice Chief of Staff. Evaluation of B-52 Bombing Operations in SEA (Southeast Asia), Third Progress Report; Project CHECO Southeast Asia Report. USAF SAC Operations in Support of SEAsia; Project CHECO Southeast Asia Report. ARC Light: June 1967 – December 1968; Marshall L. Michel III. *The 11 Days of Christmas: America’s Last Vietnam Battle*; Air Force Historical Support Division. “Operation Arc Light”

successful. MQ-9 pilots fly in combat scenarios that sometimes vary little from day to day and a mission that commanders often strictly control. When the scenario suddenly requires MQ-9 pilots to make decisions that are not daily routine, or made by a higher authority, they find themselves in a situation similar to the B-52 pilots in Arc Light.

Finally, an analysis of ICBM crew training in the 1970s presents a model for increased efficiency and effectiveness in training in an effort to improve proficiency. Research includes interviews with ICBM instructors involved in the training transitions, information from the 20th Air Force Historian, and several theses and Air University historical projects.[34] Missileers perform the nuclear deterrent job 24 hours a day, 365 days a year. Just like the RPA community, the Air Force requires them simultaneously to perform one mission, nuclear deterrence and readiness, while training for a similar but different mission, employment of nuclear missiles. The ICBM crewmembers safeguard nuclear weapons each day while training potentially to employ them. Likewise, MQ-9 pilots participate in routine combat scenarios every day while Combatant Commanders also expect Reaper pilots to be proficient at tasks they do not experience in combat on a regular basis, yet tasks of major importance and significant consequence. In the 1970s, the ICBM community altered its training philosophy at the initial qualification course and operational squadrons in an attempt to improve situational awareness and decision-making among missileers.

In addition to the three historical cases mentioned above, this study also examines operational RPA pilot-training, the training programs to develop proficiency and effective decision-making for individual MQ-9 pilots, and the training that takes place after a pilot is flying combat missions. Sources for these programs include Air Force Instruction 11-2MQ-1&9 Volume 1, the Mission Qualification Training syllabi of three MQ-9 squadrons, Training Activity Reports for simulators and flights, and multiple interviews with current MQ-9 instructor pilots, a squadron director of operations, and a

[34] Air Force Regulation 50-8. Policy and Guidance for Instructional System Development; Keith Geiger and Donald Moody, "Problems in Instructional System Development."; John N. Joyner and Robert Vineberg, *Instructional System Development (ISD) in the Armed Services: Methodology and Application*

squadron commander. All sources were either unclassified from creation or were subsequently declassified.

Lastly, I base some evidence in this work on my own experiences as both an F-16 pilot and an MQ-1 and MQ-9 instructor pilot. The work began with my own observations of MQ-9 pilot proficiency in combat and a desire to improve. It would be dishonest to say that my experiences have not influenced my research of pilot training, however, I attempt to guard against bias by utilizing sources other than my own history and knowledge to the maximum extent possible with strict peer review and a thorough thesis advisor and reader.

Scope

The objective, or the end, discussed in this paper is a proficient RPA pilot. The ways, or the methods, discussed are those used in making pilots with greater situational awareness and better decision-making ability. Methods include the machine that helps supply situational awareness, the human-machine interface, pilot-training time, pilot-training techniques, machines used for pilot training, and any other factor that increases or detracts from pilot proficiency.

This paper focuses on the proficiency of USAF pilots flying multi-role RPAs. Multi-role RPAs include aircraft involved in more than one mission. Current examples of a multi-role RPA include the MQ-1 and MQ-9. The MQ-1 will leave the USAF inventory in 2018; therefore, any reference to RPA pilots implies MQ-9 pilots. In addition, the USAF will have more RPAs that are multi-role in the near future. The principles of training a proficient RPA pilot apply equally to today's MQ-9 pilot as they do to tomorrow's MQ-X pilot.

Driven by an understanding of limited resources, this paper focuses on the operational side of combat training. Changes to the Undergraduate RPA Training course or MQ-9 formal training unit would require significant resources in both staffing and money. However, changes in operational training may not require the same amount of resources while still producing a positive change in pilot proficiency in the near-term. The historical research and any prescriptions will focus on training performed in the operational combat squadrons—continuation training.

Other personnel associated with MQ-9 operations are not a part of this analysis. Maintenance professionals, imagery analysts, intelligence professionals that fuse collected data, and sensor operators all play a significant role in the success or failure of the system. For reasons of brevity and depth of analysis, however, this study focuses on the pilot. As aircraft commander, the pilot is responsible for all combat decision-making in the weapon system. Others, particularly the sensor operators, make many decisions during a combat sortie, but the pilot owns ultimate responsibility for success or failure.

Training for War

An analysis of three case studies brings lessons from the past into the contemporary discussion. These examples demonstrate how different agencies viewed operator decision-making and what changes they implemented or failed to implement in an effort to improve proficiency. The case studies appear in chronological order.

Chapter 1 describes the Air Mail Fiasco and how aviators and organizations adapted to become better decision makers. Corrupt business executives, a severe winter, lack of training, lack of properly equipped aircraft, and lack of foresight on the part of the US Army Air Corps put pilots in a dangerous situation in 1934. The President of the United States tasked the Air Corps to deliver the US mail via air for 78 days. Pilots lacked proficiency in flying at night or in the weather and many airmen lost their lives due to poor decision-making. Air Corps leadership implemented short-term policy to curb the accident rate and then long-term policy to improve pilot proficiency in the future. From this crisis emerged a reliance on cockpit instruments to build situational awareness and enhance decision-making. The service began utilizing simulators to train pilots on the ground and prepare them for instrument flight.

Chapter 2 analyzes the manner in which Strategic Air Command employed B-52s in Vietnam. The B-52 aircrew went from missions flying a strategic asset in nuclear deterrence to conventional missions in Southeast Asia in 1965. The change in missions affected aircrew proficiency as leaders asked them to execute missions that were similar to their usual strategic missions, but different enough to require new habit patterns and decisions. The aircrews initially experienced failure: they were unable to recognize situations and mentally project courses of action to successful conclusions. Over time, they gained combat experience and Strategic Air Command adapted the missions to make them more familiar to what the B-52 crews had seen in training. The Arc Light case study illustrates reasons why the B-52 crews were not proficient at the conventional mission and how an organization adapted the mission, rather than the training or machine, in an effort to improve proficiency.

Chapter 3 describes how the Air Force adopted a new training doctrine, Instructional Systems Development (ISD), in the early 1970s in an effort to improve training effectiveness and efficiencies. Implementation of ISD at the initial qualification-training unit was a short-term fix with positive results. Sustained improvement in crewmember proficiency required a long-term fix, which involved implementation of ISD at both the initial qualification unit and combat operational units. The new training doctrine helped standardize and focus training, provided more individualized training, gave students the ability to learn from failure, and emphasized simulators and other electronic media as tools in training.

Synthesizing the contextual analogies and potential lessons for training RPA pilots, the three case studies provide insight into how the USAF may create more proficient MQ-9 pilots in the near-term and long-term. The RDA model provides a framework to analyze how organizations, pilots, and ICBM operators dealt with proficiency issues in the Air Mail Fiasco, Arc Light, and ICBM training scenarios and how the same may apply to RPA pilots today.

The Air Force should provide RPA pilots more training opportunities. MQ-9 pilots need more practice in decision-making away from the combat environment. Combat squadrons should work together to structure scenario-based training and avoid what occurs today – inexperienced pilots attempting to accomplish their own event-based training. More research on the RPA human-machine interface could lead to a more effective cockpit that enhances pilot proficiency.

Pilots depend on the machine in multi-role remotely piloted aircraft. They rely on the aircraft sensors collecting data, the communication links transmitting the data to the cockpit, and the instruments that display the data in a useful manner. Pilots did not always rely on cockpit instrumentation to gain situational awareness and make decisions, however. The next chapter describes how US Army Air Corps pilots experienced a transition in 1934 from relying solely on external references to incorporating cockpit instruments for situational awareness.

Chapter 1

The Air Mail Fiasco: Air Corps Pilot Proficiency in the 1930s

> *It is immensely important that no soldier, whatever his rank, should wait for war to expose him to those aspects of active service that amaze and confuse him when he first comes across them. If he has met them even once before, they will begin to be familiar to him.*
>
> Carl Von Clausewitz

In the early 1930s, US Army Air Corps pilots utilized their aviation instruments in much the same way as they had two decades earlier, in World War I. Pilots did not fly in bad weather or at night because they relied on visual references and "seat of the pants" cues to orient themselves and navigate the aircraft. The aircraft cockpits had few instruments and many military pilots did not know how to utilize what little information the few instruments did provide. Airpower strategists did not see the need for instrumented cockpits in combat aviation. Pilot training did not include simulators because the military placed little emphasis on cockpit instruments and leadership did not see value in the training devices. Nevertheless, the large number of accidents and loss of life in the winter of 1934 highlighted poor pilot proficiency, which changed the Air Corps' view on instrument use in aviation and simulators as training aids. Pilots lacked sufficient familiarity and experience to make the appropriate decisions flying in the weather and at night. Leadership implemented short-term policy changes in an attempt to increase pilot situational awareness and improve decision-making. Then, after the fiasco, the Air Corps made more significant changes to staffing, training philosophy, and training tools to improve pilot proficiency in flying from a world of instruments with a simulated cockpit. Ultimately, the changes created better combat aviators for World War II.

The Fiasco

Pilots in the US Army Air Corps of 1934 belonged to an organization content with the status quo. No current conflict or potential conflict existed. World War I was nearly two decades old, and few aviators in the service had been a part of the European conflict. The military budget was small and aviation received a relatively small percentage. Airmen received low wages compared to similar jobs in the private sector, and few military pilots sought out extra training. In 1934, Air Corps workdays ended at 3:30, and Wednesdays were half days. While they had available time to train, few pilots saw a need to learn to fly in weather or at night.

Two decades after the First World War, US military aviators still trained almost exclusively to the same missions types that aircraft executed in 1918. Some pilots used their aircraft to collect information on the enemy through observation. Others flew pursuit aircraft to seek out and destroy the enemy's aircraft, to gain command of the air. Other pilots flew bombing missions. Observation, pursuit, and bombing missions required the pilot to see the ground or see other aircraft in the air. Air Corps pilots believed that, if war occurred, flying skills based on information from cockpit instruments would not be necessary. In contrast, commercial aviation led the military in giving pilots instrument training and the necessary navigational aids and equipment.[1] Commercial aviation, driven by profit to deliver passengers regardless of the weather, spent the extra resources to train pilots in instrument flying, also known as "blind flying," prior to 1934.

Commercial aviation first began delivering the mail in 1918. As the nation saw the potential of airplanes to transport mail much faster than rail, the aviation mail industry grew. In 1933, airplanes delivered more than three million pounds of mail on 26 different airmail routes, covering 25,000 miles of federal airways.[2] The US Postal Service issued contracts, most to passenger airlines in their infancy, to transport the mail between major cities. In February 1934, an internal inspection by the Post Office Department revealed controversial contracts awarded to many of the mail carriers.[3] The media reported corruption and mismanaged contracts and budgets in the airmail system. Budgets were tight, and the Senate, the Congress, and the White House were all under pressure to spend taxpayer money wisely.

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[1] Borden, 37.
[2] Norman E. Borden Jr., *Air Mail Emergency 1934*, (Freeport, ME: The Bond Wheelwright Company, 1968), 9.
[3] Borden, 2.

The Post Office Department summoned Major General Benjamin Foulois to its headquarters on Saturday morning, 10 February 1934.[4] As Chief of the US Army Air Corps, General Foulois was responsible for all of the nation's military aviation organization and capabilities. He was an experienced aviator who began flying in 1910, and when he talked about airplanes and aviation, people respected his opinion and listened. It came as no surprise that the Post Office Department would seek out General Foulois in attempts to solve the politically charged topic of airmail. On that Saturday morning, Post Office leaders searched for a way to end the contracts with the commercial mail carriers but still deliver the mail. They asked if the Air Corps could pick up the airmail routes in place of the commercial carriers. According to Norman Borden, General Foulois responded, "The Army Air Corps most certainly can, but only if it is given time to prepare for the job."[5] He told the Post Office Department that the Air Corps would need four to six weeks to prepare for such an endeavor.

The Army Air Corps was not caught off-guard by the Post Office Department's request. They were aware of the political pressures involved. President Roosevelt had already discussed terminating all contracts to commercial mail carriers, and General Foulois was prepared to respond to the inquiry. He and his staff had previously calculated what the task required, and they knew a shortfall existed in both training and equipment. In their opinion, four to six weeks would be the minimum amount of time required to prepare the force for domestic mail delivery. On the same day that General Foulois met with the Post Office Department, the White House issued an executive order stating the commercial airmail contracts would be terminated on 19 February and the Army Air Corps would pick up the mail contracts in their place.[6] The President's executive order gave the US Army Air Corps nine days to prepare. The announcement surprised the service and a scramble began in an attempt to prepare pilots, planes, and airfields for a new mission. Thus began the Army Air Corps Mail Operation (AACMO).

The stringent budget, lack of instrument training, and terrible winter weather hurt US Army Air Corps pilots' abilities to deliver the mail. The winter of 1933-1934 was

[4] Borden, 3-4.
[5] Borden, 5.
[6] Borden, 7.

one of the worst winters on record and AACMO pilots confronted it head-on.[7] General Foulois called on the use of nearly every airplane in the inventory, except for training aircraft, but many of these airplanes were pursuit and observation aircraft with open cockpits.[8] Often the aircraft lacked instruments and radios; and, during the nine days between executive order and the first AACMO flights, maintenance depots worked furiously to install whatever instruments and radios were on hand in the poorly equipped planes.

Even when the planes had a semblance of instrumentation in the cockpit, not all pilots knew how to utilize the aviation tools. The average pilot had approximately five hours of "under the hood" blind-flying time when AACMO began.[9] Many Air Corps pilots had so little confidence in instruments and their ability to fly off them that they chose rather to take a chance by "sneaking through mountain passes, flying contact, even at night, rather than climb into the overcast and fly blind."[10] Pilots lacked the knowledge to maintain situational awareness without looking outside the cockpit. If they could not see the ground, they lacked the skills necessary to determine and control the attitude and position of the aircraft effectively, let alone make adequate decisions regarding their mission. For most 1934 Army Air Corps pilots, the source of their navigational and orientation situational awareness was mother earth. Without her, they could not make good aviation decisions regarding navigation.

The combination of severe weather and little experience in blind flying proved deadly. US Army Air Corps pilots lost their lives even before the service began officially delivering the mail on 19 February. On 16 February, during route orientation flights, three airmen lost their lives in two fatal crashes. Lieutenants J.D. Grenier and Edwin D. White crashed an A-12 between Cheyenne, Wyoming, and Salt Lake City, Utah, during a

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7 Rebecca Hancock Cameron, *Training to Fly: Military Flight Training 1907-1945,* (Air Force History and Museums Program, 1999), 267.
8 Borden, 32.
9 Borden, 41. "Under the hood" refers to pilots training to fly using instruments inside the cockpit. To prevent student pilots from using external references for situational awareness, instructors positioned a hood over the cockpit, forcing students to rely on the information provided by the cockpit instruments.
10 Borden, 97.

snowstorm (Figure 3 and 4). That same day, Lieutenant James Y. Eastham crashed a B-7 in a night fog near Jerome, Idaho (Figure 5).[11]

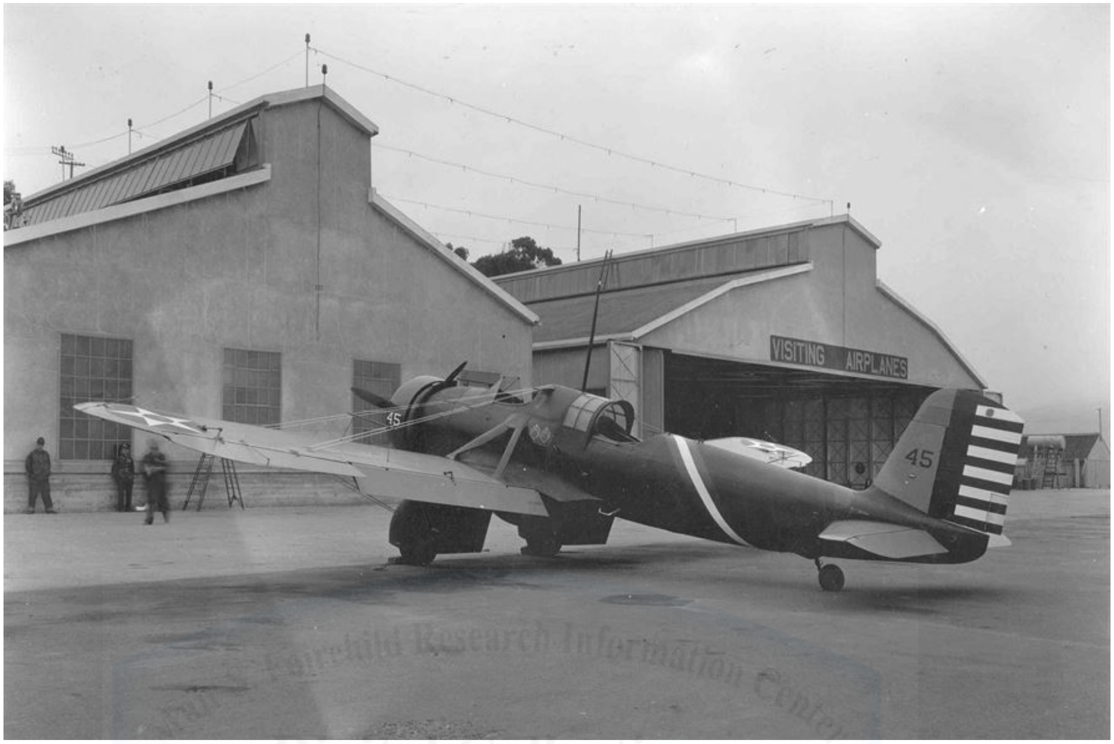

Figure 3. Curtiss A-12 Shrike
Source: National Museum of the US Air Force

[11] Carroll V. Glines, *The Saga of the Air Mail,* (Princeton, NJ: D. Van Nostrand Company, Inc, 1968), 132.

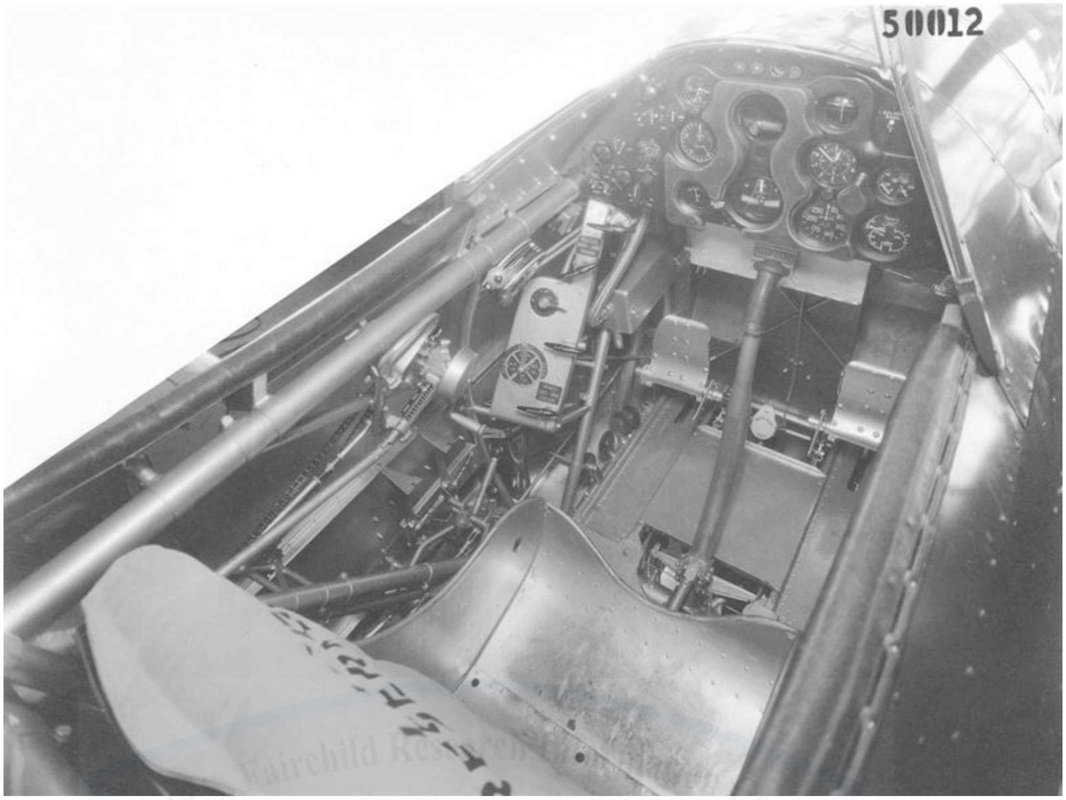

Figure 4. A-12 Cockpit, July 1934
Source: National Museum of the US Air Force

Figure 5. Douglas B-7 Medium Bomber
Source: Airminded.net

The Initial Response: Policy Changes

Air Corps leadership was not ignorant of the deficiencies in training and equipment. General Foulois knew he needed more time to prepare but attempted to make the best out of a difficult situation. On 16 February, the same day as the first three deaths, General Foulois issued a radiogram to all AACMO zone commanders. "Before clearing any scheduled trip, careful consideration will be given to the experience of personnel, suitability of aircraft, night flying equipment and blind flying equipment. Steps will be taken to indoctrinate all personnel engaged in air mail operations with the above principles."[12] He understood most of his pilots lacked proficiency to fly at night and in the weather, as well as the instruments and equipment to execute such a task.

An analysis of General Foulois' statement leads one to believe that he recognized the root cause of the Air Corps' problem in 1934—pilots with poor situational awareness and decision-making skills. First, he requires zone commanders to consider "the experience of personnel." Pilots with greater experience are more likely to confront familiar scenarios. If pilots make decisions by mentally simulating a course of action and project the situation forward in time to a logical conclusion, then pilots with greater experience are more capable of mentally projecting the correct course of action forward. They have better recognition of goals, cues, causal relations, and expectancies. The fact that they have seen similar scenarios and the resulting consequences gives them greater ability to make the correct decision and select the correct course of action. It is more likely that an experienced pilot's mind knows the correct course of action. Foulois also recognized that situational awareness was essential to decision-making. The "night flying equipment and blind flying equipment" were tools to give a pilot situational awareness. Many of the aircraft in the Air Corps' inventory lacked the instrumentation to communicate to a pilot where the aircraft was and where it needed to go. Without a suitable aircraft equipped with tools to provide situational awareness operated by experienced aviators, pilots were less likely to make proper decisions and fly their aircraft safely.

[12] Borden, 50-51

Nevertheless, inexperienced Air Corps pilots bravely accepted the mission, made poor decisions while airborne, and accidents continued to occur. On 9 March, the Air Corps lost another four airmen. Pilots' poor decisions resulted in deaths and poor publicity for the organization. The poor publicity also reflected on those who decided to give the airmail responsibility to the Air Corps, including the President of the United States.

After receiving a "tongue lashing" from President Roosevelt, General Foulois issued three orders which reduced the quantity of mail delivered but also reduced the rate of accidents: all blind flying-instruments be inspected and properly re-installed, only pilots with two years of experience or more would fly, and pilots would fly only routes with a forecasted minimum ceiling of 3,000 feet.[13] All cockpits had to have operational instruments, only the most experienced pilots could fly, and those pilots would fly only if they could see the ground. The Air Corps recognized that its pilots lacked situational awareness in the weather and that more experienced pilots were more likely to make sound decisions because they were more familiar with the environment. The last order, to fly only in good weather, can translate to the Army Air Corps recognizing that the organization as a whole lacked pilot proficiency in instrument flying. Operational exigencies, insufficient staffing, lack of training emphasis, and lack of training equipment in blind flying prevented the organization from improving proficiency while the Army Air Corps Mail Operation continued. General Foulois could do little to improve pilot proficiency during operations. He could only change policy to put the most proficient pilots airborne with the greatest potential for situational awareness in a wider range of scenarios.

AACMO finally terminated operations on midnight, 7 May 1943, and the airlines resumed flying the mail after a 78-day hiatus. During the operation, 66 accidents over 14,745 flight hours led to 12 deaths.[14] Ironically, not a single ounce of mail was lost during the entire operation.

The loss of life and equipment in the Air Mail Fiasco brought attention to US Army Air Corps' needs—the need for better funding, better equipment, and better

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[13] Borden, 108-111.
[14] Borden, 135.

training. The Congressionally tasked Baker Board convened over a three-month period to review the Army Air Corps operation. Some of the boards suggestions included: more aircraft, more personnel, a separate General Headquarters (GHQ) Air Force to report directly to the Army Chief of Staff, a greater emphasis on instrument training, and ten more hours of flying time per month for each pilot.[15] The attention brought on by the Air Mail Fiasco helped the service obtain the level of funds needed to modernize both equipment and training.

The Solution: Simulation in Training

Early AACMO deaths drove the organization to innovate and attempt new training methods. Even before the Air Mail Fiasco, select leaders and pilots critical of the Army Air Corps' performance foresaw a need to train with instruments in their cockpits.[16] These airmen struggled to convince policy-makers that the Air Corps needed to emphasize blind flying and training in general, however. If a pilot flies in good visibility, visual references outside of the cockpit are sufficient to orient the aircraft and navigate. This is how aircraft flew in World War I. If weather or darkness prevents the pilot from seeing the ground or a discernible horizon, however, then the pilot must rely on cockpit instruments to orient and navigate. Instruments help provide the pilot situational awareness on aircraft orientation and navigation. Cockpit instruments help inform the pilot which way is up and where the aircraft needs to point in order to reach a destination. The prescient airmen struggled to convince leadership to act because few airmen and leaders saw a need to spend resources on a skill not required for current combat missions. The Corps eventually established two navigation schools, but the 1934 fiasco interrupted training when operational leadership removed the second class so it could participate in the airmail operations.[17] The training was too little and too late. The Air Mail Fiasco became the catalyst that moved the Air Corps to recognize the

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15 Borden, 138-140. Cameron, 268.

16 Jimmy Doolittle is an example of one airman critical of the Air Corps' lack of proficiency in "blind flying." In 1929, he became the first pilot to fly an entire sortie without using any visual references outside the cockpit. He relied solely on the data provided by instruments to take off, fly, and land an aircraft. James H. Doolittle, *I Could Never Be So Lucky Again,* (New York, NY: Bantam Books, 1991), 137-144.

17 Cameron, 268.

importance of instruments in the cockpit and men trained to use the machine for situational awareness and improved decision-making. The simulator became an innovative tool to train pilots how to utilize instruments in the cockpit.

Ed Link manufactured the first military aviation simulator, the Link Aviation Trainer or "Link Trainer." The Link Trainer was a device resembling a small airplane. The trainee sat in the cockpit of the trainer where a full set of instruments and controls provided a virtual environment in which to train. A small pair of wings with ailerons and a vertical tail with rudder provided visual feedback to the instructor when the trainee actuated the controls. A pneumatic billow underneath the device moved the airplane in pitch and yaw.[18] The Link Trainer could be set up on the floor of a hangar or other building (Figure 6).

Figure 6. Link Trainer
Source: Air Force Historical Research Agency

To promote his simulator, Ed Link trained his brother, George, to fly using a combination of virtual training and live-fly training. George was able to successfully fly an aircraft solo after only six hours of training in the Link Trainer followed by a mere 42

[18] Borden, 101.

minutes of actual flight training.[19] Ed proved the Link Trainer could successfully train pilots when combined with live-flight training. In an article in the New York Herald Tribune, Link proclaimed that 15 hours of "hangar flying" and five hours of blind flying training were equivalent to 25 hours of blind flying instruction in an aircraft alone.[20]

The Air Corps also received a prototype simulator as early as 1932, a full two years before the President tasked the service to transport the mail.[21] The New Jersey unit that received the simulator was so impressed that they shipped the unit to headquarters in Washington DC with a recommendation to purchase more. Many staff officers agreed with New Jersey's assessment, but budget considerations ruled the day and the Air Corps did not purchase any new simulators. In Pensacola, the Navy received the same simulator prototype. The base commander was "deeply impressed," but again, budget constraints within the Navy caused the simulator to suffer the same fate as it did in the Air Corps.[22]

After the initial accidents and deaths of the Air Mail Fiasco, AACMO leadership searched for ways to improve pilots' abilities to fly using instruments. On 3 March, Lieutenant Orvil A. Anderson, the senior AACMO instructor in the Eastern Zone, witnessed a demonstration of the Link Trainer.[23] He was so impressed with the simulator and so anxious to curb the rate of accidents due to poor instrument flying that he ordered ten to be delivered in June. The Link Trainer did not arrive in time to have an impact on the Air Corps mission during the airmail operations, but the trainer became a staple of pilot training. Out of the Air Mail Fiasco arose a more effective and efficient method to train pilots. The nation's military air service needed a catalyst for change in training, and the struggles of 1934 quickened the Air Corps' training emphasis on blind flying and instruments and incorporated the use of simulators in pilots' qualification and training regimen.

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19 Lloyd L. Kelly, as told to Robert B. Parke, *The Pilot Maker* (New York, NY: Grosset and Dunlap, 1970), 32.
20 Kelly, 41.
21 Kelly, 52.
22 Kelly, 38.
23 Borden, 99.

Instructors quickly learned the usefulness of the tool in teaching pilots blind flying. Just two years after the Air Mail Fiasco, the Air Corps owned 21 Link Trainers.[24] Less experienced pilots trained on the simulator to learn an instrument crosscheck and how to navigate without seeing the ground.[25] More experienced pilots used the Link Trainer to maintain skills and proficiency in instrument flying. The simulator also provided a tool for instructors to standardize training as they could observe each other instruct, view different flying techniques, and receive instruction from more experienced pilots. Instructors could also introduce a variety of malfunctions and emergencies to provide both teaching and assessment opportunities without putting the student or aircraft at risk.

Despite all the benefits it brought to pilot instruction, the Link Trainer also had limitations. The device's ability to provide feedback both to the student pilot and the instructor was limited. A completely accurate representation of realistic instruments to the student was also not possible in early simulators. In 1934, the Army Air Corps purchased a single type of simulator cockpit that displayed instruments in a specific arrangement. Real aircraft cockpits, however, displayed instruments in a variety of different arrangements. In addition, the instructor could not see all of the student's actions in the device and the trainer limited the amount of data instructors could receive on student decision-making and execution. Student pilots gained situational awareness from their instruments and made decisions based on the received data. Nevertheless, neither the student nor the instructor could mentally project the selected course of action all the way through to a completely realistic conclusion. The Link Trainer offered event-based training to students, but 1934 technology limited the quality of scenario-based training. A creative instructor could weave events together into a semblance of a scenario, but the simulator lacked the fidelity to run entire realistic missions. The

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[24] Cameron, 266.

[25] Flying without external references requires pilots to maintain situational awareness based on information from multiple cockpit instrument displays. To coalesce and interpret all the data, pilots must maintain a disciplined instrument crosscheck. They must reference the right display at the right time and continuously transition their eyes from one display to another and back again. If they spend too much time on a single display or neglect important presented data, then pilots can lose situational awareness.

decided-upon course of action required assumptions and imagination to mentally project forward to the end state.

Another limitation of the Link Trainer was its finite ability to represent the contemporary aircraft flown. Air Corps pilots flew numerous aircraft with different cockpit layouts and instrumentation. The Link Trainer, however, had a single configuration of instruments and could not be modified to represent the cockpit of each aircraft. The limited configuration forced pilots to learn a specific instrument layout and crosscheck in the Link, then learn a different instrument layout and crosscheck in the actual aircraft they flew. Simulator training also introduced the potential for development of bad habit patterns and non-transferrable training to the actual aircraft. At a minimum, the Link Trainer introduced the need for a pilot crosscheck inside the cockpit and instilled confidence in a student's ability to fly the aircraft in conditions other than day and clear weather. Nevertheless, some habits came at a cost; most pilots re-learned a new crosscheck in the actual aircraft they flew.

Even the device's inventor, Ed Link, understood that simulator training was a supplemental tool to training in an actual aircraft. The Link Trainer in 1934 lacked the proper visual and kinesthetic capabilities to provide the student realistic feedback on control inputs. The pneumatic billows moved the simulator in pitch and yaw, but the limited motions and lack of visual references could only weakly approximate live-flight. Simulator training could not replicate precipitation, fog, clouds, darkness, or the complex sensory inputs inherent to the six degrees of freedom in the motion of a real aircraft that could disorient a pilot. The simulator also failed to reproduce the stress a pilot experiences in a life-or-death situation.

After the Pensacola commander witnessed the Link Trainer's capabilities, he recommended cutting his base's live-flight instrument training time in half and supplementing with the simulator. Ed Link cautioned against such a drastic move, and recommended the Navy keep the programmed five hours of blind flying time but added the Link Trainer simulator time as an addition to actual flight time.[26] Ed Link made this recommendation despite the fact that his company was not doing well financially, and he

[26] Kelly, 39-40.

desperately needed the Navy to buy his simulators. The Navy was interested in purchasing five more trainers with a price tag of $1500, the equivalent of $27,000 in 2016.[27] Nevertheless, Ed Link recognized the simulator was not a direct replacement to live-fly training but rather a supplement to it and therefore recommended against complete dependency on simulator training.

Combat Preparation

The situational awareness and decision-making skills acquired by pilots in the Link Trainer led to more proficient combat aviators in World War II. With systemic training changes, including the Link Trainer, the Air Corps provided more opportunities for pilots to make decisions. According to the RPD model, when decisions made in real life involved scenarios similar to situations they faced in training or scenarios previously experienced, pilots were more likely to select the best course of action. The more scenarios and opportunities to practice decisions Air Corps pilots experienced, the more likely they were to make the correct decision in live flight. The Link Trainer provided a forum to experience scenarios to practice decision-making in both quantity and quality. Pilots learned to make decisions based on situational awareness gained from within the cockpit. This was a concept not emphasized in military pilot training until after the Air Mail Fiasco. It was a skill World War II aviators would need as they flew much more sophisticated aircraft than their predecessors in World War I. The World War II pilots would be required to interface more with their machines and make decisions based on that interaction. Emphasis on airmanship before combat began created better decision-makers for World War II.

Despite its limitations, the Link Trainer improved pilot proficiency. It provided a means for instructors to show students how to increase situational awareness. Students developed habit patterns in where to look in the cockpit for information. The instructors could then manipulate the information to present pilots limited scenarios that forced decision-making. After selecting a course of action, students witnessed the resulting consequences, albeit in a limited and virtual environment. Seeing the results of their

[27] Based on an annual inflation rate of 3.58%.

decisions allowed the student pilots to build mental simulations of specific courses of action.

The accumulated experiences in the simulator gave pilots cognitive tools to improve decision-making. When pilots flew into weather or at night, they made many decisions similar to those made in the Link Trainer. The simulator experiences helped pilots mentally project from a decision to a positive logical conclusion because they had had that experience and knew the best avenues to achieve the desired end-state. With scenario training, the pilot could recognize familiar goals, cues, causal relations, and expectancies. The Link Trainer provided pilots the opportunity to practice decision-making and then analyze the result. If the decision was incorrect, instructors could figure out what the student's situational awareness was or what the student believed would be the end-result of a selected course of action. The instructor could then correct the error and help the student see what the correct decision was and more importantly, why. Students learned as much from their mistakes as they did their successes, and the Link Trainer provided a safe environment for such learning.

The failures of AACMO forced changes in equipment and training. In World War I, pilots flew by the seat of their pants. They believed they could determine the attitude of the aircraft by sensing movement and acceleration with their proprioceptive apparatus, or the seat of their pants. Instructors taught student pilots to monitor the aircraft's engine by listening for change in the rhythm of the motor.[28] Between 1918 and 1934, this philosophy of flying by looking almost exclusively outside of the aircraft and monitoring aircraft performance through feel and sound continued. The Air Mail Fiasco, however, taught the Air Corps that the seat-of-the-pants aviation mentality was inadequate and even dangerous in certain situations. The Air Mail Fiasco forced Air Corps pilots to look inside the cockpit for situational awareness. The external data points and references were still important, but more sophisticated aircraft, instruments, and sensors required pilots to absorb more information inside the aircraft to make decisions. Beyond the traditional feel and sight references outside of the aircraft, pilots would be required to build situational awareness with instruments inside the cockpit. With the

[28] Lee Kennett, *The First Air War: 1914-1918* (New York, NY: Simon and Schuster, 1991), 106.

advancement of aviation technology, aircraft became faster and more maneuverable. Even with visual cues from outside the cockpit the machine could disorient the human because planes began to move in ways that pilots' senses could not decipher. The Link Trainer provided the tool to teach pilots to trust an artificial representation of their orientation to and movement through this environment. They learned to trust their instruments. In a way, virtual reality preceded the digital computer by about 50 years.

AACMO also highlighted the need to improve the machine. The 1934 winter showed airmen the need to rely on the machine for situational awareness. Nevertheless, to be valuable, the machine had to provide the correct information in a format that pilots could interpret. Displaying the information was one thing, but displaying the information in a format that gave the pilot situational awareness was essential to decision-making.

Besides use of the simulator in training, the Air Mail Fiasco instigated other long-term improvements to US military aviation. The Air Corps chain of command changed, reporting directly to the Army Chief of Staff as recommended by the Baker Board. Congress gave the Air Corps a larger budget to procure more modernized aircraft, more personnel, and provide more dedicated training time to pilots and the organization focused on training. Training was not an organizational priority before 1934, but received more emphasis afterword.

The Air Corps failures in 1934 led to changes in training methods, training quantity, combat machines, and the human-machine interfaces of those machines that ultimately created more proficient aviators. The results of increased resources and more focused training prepared the Air Corps and its aviators for the rigors of World War II.

Conclusion

Although the Air Mail Fiasco cost the nation twelve brave airmen, the highly public failure led to positive changes in the US Army Air Corps training philosophy. Pilots who lacked proficiency before AACMO received training afterwards that improved their situational awareness and decision-making capabilities. The US Army Air Corps moved beyond a status-quo organization to one that sought improvement.

Indirectly, the fiasco helped the US Army Air Corps prepare for World War II with both equipment and personnel readiness.[29] The Army Air Corps modernized its infrastructure and fleet of aircraft. It focused on pilot proficiency by increasing the required amount of training time per pilot. This training time occurred monthly, even after pilots had demonstrated proficiency in their initial-qualification training. The new training policies required them to execute continuation training in order to maintain proficiencies. The Air Corps recognized what the RPD model highlights—pilot proficiency depends on airmen's abilities to recognize the environs and select a familiar course of action. With increased training, Air Corps pilots could access information stored in memory when required.[30] When US Army Air Force pilots entered combat in Europe and the Pacific, they were more proficient than Air Corps pilots of 1934 due to aircraft that provided increased situational awareness and training that improved decision-making through limited scenario-based training and experience.

One of the important tools to prepare pilots for combat decision-making in World War II was the simulator. The Link Trainer proved invaluable in training US Army Air Corps aviators to gain situational awareness from within the cockpit and base decisions on that data. The simulator gave students the opportunity to see and practice how they could gain situational awareness and make decisions in an environment where mistakes did not result in loss of life or destruction of property. Pilots could practice flying an airplane without the negative consequences attached to making poor decisions. Instructors could identify for the student where a pilot should look to gain and maintain situational awareness. Pilots developed habit patterns in where to collect information and what to do with it. The Link Trainer allowed students the opportunity to make decisions and see the associated consequences of each decision. The simulator was good decision-making practice, and good practice led to improvement. Many of the Link Trainer students went on to fly combat in World War II, and their experiences in simulators prepared them for decisions in war.

[29] Borden, 142.
[30] Daniel Kahneman, *Thinking, Fast and Slow,* (New York, NY: Farrar, Straus and Giroux, 2011), 11.

The Link Trainer and increased focus on training in general was not without limitations or cost. It was not a direct replacement of live-fly training but rather a supplement to actual flight. While the Link Trainer existed in a single format, the Air Corps used aircraft and aircraft cockpits in a variety of configurations. The simulator was unable to realistically emulate all the cockpit configurations. The Link Trainer was also limited in its ability to execute scenario-based training. Students could practice specific events, but the simulator could not duplicate night, clouds, aircraft acceleration, or all the conditions required to create a stressful scenario, similar to what the pilot would experience airborne. The Link Trainer was also not cheap, and leaders had to prioritize the purchase.

In the Air Corps' pursuit of proficiency, the service began to emphasize training in general and instrument training specifically. The Baker Board's recommendations to the Congress communicated the Air Corps' needs in personnel, equipment, and organizational changes, and the Congress responded with increased funds. This allowed the US Army Air Corps to increase staffing, purchase new aircraft, and upgrade instruments in existing aircraft. Following the board's recommendations, each pilot received an additional ten hours of training per month.

The Air Mail Fiasco illustrated the importance of the human-machine interface in decision-making. Without proper instruments or training to read the instruments, bad weather limited a pilot's ability to make the correct decision. Once the cockpit displayed the proper information in an interpretable format to the pilot, he could make and execute an informed decision, assuming he received the training.

Decision-making was just as important for pilots of the Army Air Corps in the 1930s as it was for B-52 pilots in the 1960s. The Air Mail Fiasco forced pilots not proficient in instrument flying into situations where poor decisions led to aircraft accidents and death. The next chapter analyzes B-52 pilots during Vietnam who were extremely capable at a very specific mission before the Air Force asked them to demonstrate proficiency in a new, more dynamic scenario. The Air Mail Fiasco highlights how an organization adapted its training philosophy and technology to improve pilot proficiency. Pilots became experienced and better decision-makers through situational training. The next chapter also highlights how flying experience creates pilots who are more proficient but also shows how an organization chose to adapt the mission itself rather than improve pilot proficiency through training or technology.

Chapter 2

Arc Light: Bomber Pilot Proficiency in Vietnam

To plan maneuvers so that some of the elements of friction are involved, which will train officers' judgment, common sense, and resolution is far more worthwhile than inexperienced people might think.

Carl Von Clausewitz

The use of B-52s in Vietnam provides another case study where the operational environment forced pilots and aircrew to execute unfamiliar and unrehearsed missions. Much like the Air Mail Fiasco, these pilots initially struggled in proficiency. Before the Arc Light sorties of Vietnam, B-52 pilots trained to fly an extremely important, but well scripted, nuclear mission. For the Vietnam War, however, they received a task to fly their aircraft and employ weapons in a more fluid environment that required dynamic decision-making. The Arc Light missions in 1965 spurred pilots into unfamiliar territory that tested their combat cognitive abilities. Aircrew made poor decisions as they executed a much more dynamic mission than the scripted scenarios they trained and prepared for in the Cold War. This chapter briefly outlines the change in mission, planning, and mindset, with a focus on the very first B-52 mission flown over South East Asia, Arc Light 1.

Cold War Training

Long-range bombers capable of delivering nuclear payloads played a valuable role during the Cold War. The B-52, one leg of the nuclear triad, fell under the auspices of Strategic Air Command (SAC) when the United States entered Vietnam in the 1960s. Nuclear weapons allowed the airpower theories of Giulio Douhet and Billy Mitchell a renewed pre-eminence in USAF doctrine and strategy as the nation countered the existential threat of the Soviet Union and nuclear war. The United States depended upon deterrence of the Soviet Union. If deterrence failed, then the United States could defeat the Soviets with long-range strategic bombers, nuclear-armed intercontinental ballistic missiles, and submarines capable of delivering nuclear missiles.

Boeing designed the B-52 in the 1950s as a means to deliver nuclear bombs to the Soviet Union. The intent was to launch the aircraft from the continental United States, carry a nuclear payload a great distance assisted by in-flight-refueling aircraft, penetrate Soviet defenses, and strike pre-planned targets. The XB-52 flew for the first time on 15 October 1952 and went through the Air Force's flight test program over the next two and a half years.[1] The first operational B-52 arrived at Castle AFB, California, on 29 June 1955.[2] Still active at this writing, it is the longest serving bomber in US history.

General Curtis LeMay was Chief of Staff of the Air Force in 1965. He was a former bomber pilot and leader from World War II, as well as SAC commander following the war. His nuclear-bombing mentality was prevalent in much of the USAF leadership. Even as an asymmetric threat began to rise in Vietnam, USAF leadership maintained focus on the existential threat, the Soviet Union. The French failures in opposing the threat in Southeast Asia still did not shake the Air Force nuclear-bombing mentality. In a 1962 article titled, "Air Power in Guerilla Warfare," General LeMay concluded, "general war poses the primary military threat to the security of the Free World, and it is under the umbrella of strategic superiority that the United States has freedom of maneuver in the lesser forms of conflict."[3] For LeMay, the most important mission of the B-52 was to maintain a credible threat to the Soviet Union, and to give the B-52 aircrew any other mission than nuclear deterrence was to waste a precious national resource.

The goal of nuclear deterrence caused SAC to develop a very specific and regimented mission for B-52 aircrew. Airmen were prepared to launch quickly in case of a surprise nuclear attack, or launch expeditiously as directed by National Command Authority. The need to execute quickly necessitated a command-and-control system where SAC chose pre-planned aircraft routes and targets well in advance of missions. SAC headquarters, in Omaha, Nebraska, planned every detail ahead of time and de-conflicted all the nuclear missions from one another. All planning also took place at SAC headquarters, and the system trained aircrew to execute the detailed plans without variance. Headquarters retained all decision authority regarding any detail of SAC

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[1] Head, "War From Above the Clouds," 13.
[2] Head, "War From Above the Clouds," 13.
[3] William P. Head, "War From Above the Clouds: B-52 Operations during the Second Indochina War and the Effects of the Air War on Theory and Doctrine." (Maxwell AFB, AL: Air University Press, July, 2002), 15.

missions and gave aircrew, or even field commanders, little flexibility in altering the missions.[4]

SAC created aircrews very disciplined and standardized, but simultaneously discouraged initiative and critical thinking. The B-52 crew's role was to execute the mission, nothing more, and nothing less. They were to launch as quickly as possible, fly to a designated target over the Soviet Union after rendezvousing with in-flight refueling aircraft in route to the target, and deliver a nuclear payload using radar-synchronous bombing. This mission required strict adherence to manuals and checklists with serious consequences to any deviations from them. The mentality of rote discipline and standardization developed over time. As new pilots became members of the SAC community, they learned unquestionably to follow the plan given to them from headquarters. One member of SAC described the command atmosphere in the 1970s, "Headquarters said jump, and we barely asked how high."[5] The ways the organization rewarded and disciplined behavior created apathy concerning decision-making. SAC headquarters made all the important decisions for the pilots; aircrews had only to execute the plan.

What mission planning the B-52 aircrews did accomplish was mostly administrative. It consisted of reviewing the mission folders given to them by SAC headquarters. The pilots and crews were not making critical decisions concerning the mission but were instead following administrative checklists and filling out paperwork. B-52 pilot Bill Hart stated, "When the gross weight of the paperwork equals the gross weight of the airplane, you are cleared for takeoff!"[6] SAC headquarters made all decisions on what route to approach the target, how to avoid enemy defenses, what altitudes to fly, where to aim the weapons, what weapons to use, and how to fuse the weapons. The aircrews compiled all these pre-planned decisions into a mission and simply executed.

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[4] Marshall L. Michel III, *The 11 Days of Christmas: America's Last Vietnam Battle,* (San Francisco, CA: Encounter Books, 2002), 4.
[5] Danny Cochran, USAF Retired, to the author, e-mail, 11 March 2016.
[6] Don Harten, *Collision Over Vietnam: A Fighter Pilot's Story of Surviving the Arc Light One Tragedy,* (New York, NY: Turner Publishing Company, 2011), 18.

B-52 aircrew training missions were monotonous. SAC required pilots and other aircrew to fly training sorties in order to maintain proficiency in the nuclear mission, and plans required continuation training on a regular basis. During long training sorties, aircrew needed just a few minutes to accomplish their training events. For example, after take off and climbing to altitude, navigators directed pilots exactly where to fly the aircraft based on the plans in a mission folder. Pilots turned into voice-activated steering mechanisms for the remainder of the sortie. B-52 co-pilot Don Harten described these mindless training missions, "Most of the time in the air during these butt-numbing training flights was spent on navigation legs."[7]

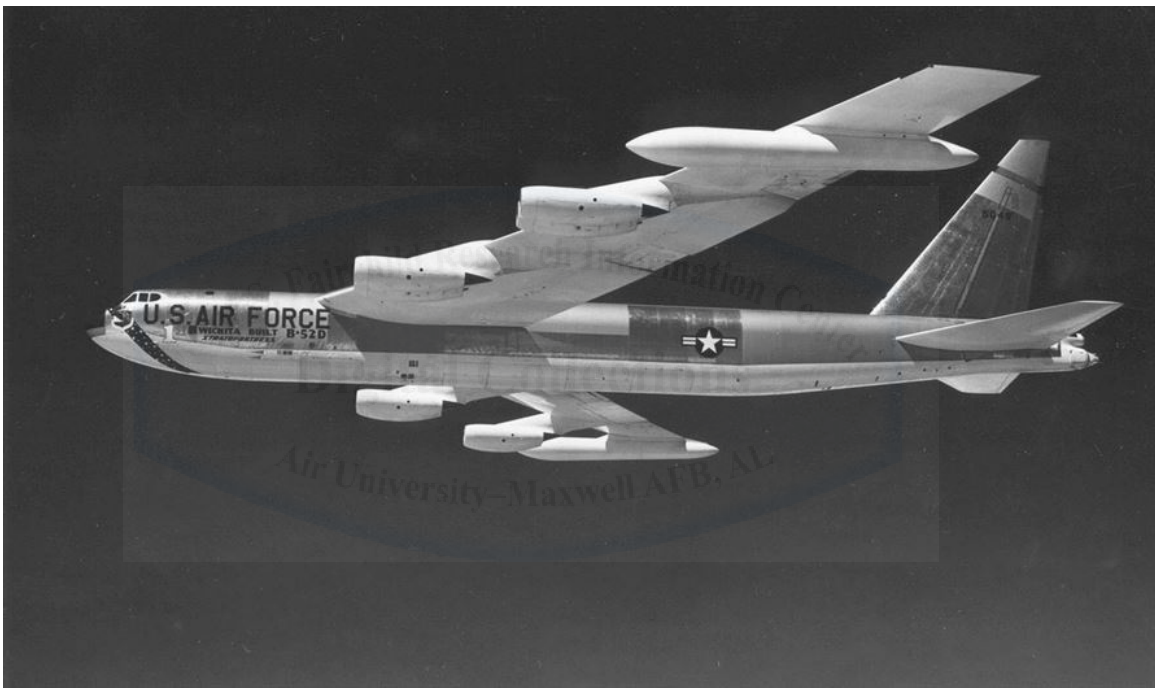

Figure 7. Boeing B-52
Source: National Museum of the US Air Force

In addition to dedicated navigation-training sorties, B-52 crews flew Chrome Dome missions and sat alert. The Chrome Dome missions were extremely important, but very repetitive for the aircrew. To maintain nuclear readiness, SAC kept B-52s continuously airborne over the Arctic on missions that lasted up to 28 hours (Figure 7). Bomb Wings from different bases alternated months on the Chrome Dome missions.

[7] Harten, *Collision Over Vietnam,* 20.

Pilots reported, "turning their brains off" as they flew circle after circle over the cold north.[8] The other important task B-52s accomplished in their strategic mission was sitting alert. Similar to the Chrome Dome missions, the alert shifts alternated between Bomb Wings. For three to four days at a time, a B-52 crew staffed an alert facility where, if called upon, they could rapidly get an armed B-52 airborne and transiting towards pre-determined targets in the Soviet Union.

The B-52 in Vietnam

Despite Air Force leaders' protests, the B-52 deployed to participate in the campaign in Southeast Asia. Thirty B-52F models deployed to Guam in March of 1965. The bombers were part of SAC OPlan 52-65, issued in mid 1964. The OPlan comprised the framework for operations known as Arc Light in which B-52s struck selected targets with conventional, non-nuclear, weapons.[9] Arc Light were ground-support missions flown at high altitudes over South Vietnam, Cambodia, and Laos. Their goal was to support Allied ground forces by interdicting northern infiltrations of troops or supplies. The intent was to fly the bombers at altitudes where the enemy would neither see nor hear them, minimizing air defense threats, and strike large-area targets. In mid-1968, three years after they began, the stated mission of Arc Light was: "to assist in the defeat of the enemy through maximum destruction, disruption, and harassment of major control centers, supply storage facilities, logistic systems, enemy troops, and lines of communications in selected target areas."[10] The Arc Light missions began on 18 June 1965 and terminated on 15 August 1973.[11]

President Johnson hesitated in using B-52 bombers in North Vietnam, fearing large civilian casualties and collateral damage. He also feared escalating the conflict by sending an unintended message with the US bomber force over the North. Political restrictions on targets in North Vietnam caused an "aerial role reversal" as Navy and Air

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8 Harten, *Collision Over Vietnam,* 158.
9 Project CHECO Southeast Asia Report. *USAF SAC Operations in Support of SEAsia.* HQ PACAF, 17 December 1969, X. Document is now declassified.
10 Project CHECO Southeast Asia Report. *USAF SAC Operations in Support of SEAsia,* 3.
11 Head, "War From Above the Clouds," 17.

Force fighter aircraft struck strategic targets in the north while B-52s flew tactical support sorties in the South.[12]

Air Force leaders and officials at SAC also did not want the B-52 involved in Vietnam. They were not happy with the role assigned to SAC in Arc Light, as it did not coincide with their traditional concept of nuclear posture.[13] According to SAC, the nation needed the aircraft and crews as a nuclear deterrent, and B-52s in Vietnam would degrade that deterrent.[14] Nevertheless, events and political decisions overcame Air Force desires, and B-52s deployed to Guam. Their deployment, however, came at a compromise—the B-52 bombers must remain under SAC operational control. Not only would SAC Headquarters in Omaha, Nebraska, approve targets and dictate the number of aircraft, it would determine the tactics B-52 crews would fly over Vietnam.[15]

The task given to B-52s in Arc Light missions was at variance with established Air Force doctrine. The B-52 was a strategic asset, and Arc Light was not a strategic campaign. It was not until the Linebacker campaigns of 1972, especially the December bombings of Linebacker II, that the USAF used B-52s in a strategic role. Through the Arc Light missions, the B-52 executed what doctrine labeled a "tactical" mission. Historian William Head stated, "In 1965 the concept of operational bombing procedures for large scale non-nuclear strikes was inconsistent with existing SAC material concepts since B-52 crew training and doctrine were designed for strategic nuclear conflict."[16] In 1969, four years after the beginning of Arc Light missions, Headquarters Pacific Air Forces conducted a study into the B-52 mission. The report states, "In the Arc Light bombing effort, the B-52s were being utilized in a role far different from their original intent. They were being employed in a role normally reserved for tactical fighters, whereas they had been designed for strategic operations and, prior to their use in Southeast Asia, had been primarily oriented toward nuclear alert operations."[17] A B-52

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[12] Head, "War From Above the Clouds," 4-5.
[13] Head, "War From Above the Clouds," 17.
[14] Michel, *The 11 Days of Christmas,* 12.
[15] Marshall L. Michel III, *Clashes: Air Combat over North Vietnam, 1965-1972,* (Annapolis, MD: Naval Institute Press, 1997), 273.
[16] Head, "War From Above the Clouds," 18.
[17] Project CHECO Southeast Asia Report. *USAF SAC Operations in Support of SEAsia,* 2.

pilot who flew Arc Light missions described his frustration, "Instead of bombing supply depots, airfields, docks, railroad yards, bridges, petroleum storage, troop concentrations, infrastructure, etc., we were forced to go against smaller, nothing targets in a jungle where we couldn't see what we'd hit."[18]

In addition to their fear of weakened nuclear deterrence with B-52s deployed overseas, SAC planners also worried the B-52 aircrew would have proficiency problems in Southeast Asia. SAC feared the B-52 technology and aircrews were not designed and trained to execute the Arc Light taskings. In 1965, B-52 crew training focused on nuclear conflict. Aircrew trained to use radar to locate ground targets. The terrain in Vietnam provided few offset aiming points or specific ground references to assure accurate radar navigation and bombing.[19] When Arc Light began, very little radar data was available in Vietnam. Aircrew had not trained to strike targets using visual reference cues, nor did they train to navigate and overfly triple-canopy jungle. The Air Force attempted to solve this ground-reference problem by seeding homing and targeting beacons into the target areas, which would give the B-52 aircrew an idea of where the targets were.[20] SAC planners hoped to return to radar-synchronous bombing once they could build up sufficient radar files. They feared that B-52 pilot proficiency in a non-nuclear mission would be inadequate and attempted to design the Arc Light missions to resemble the nuclear missions as much as possible, as soon as possible. Nobody believed the B-52 missions in Vietnam were overly complex, but they were different than the nuclear mission that crews had trained to execute daily.

Catastrophe - Arc Light 1

The fears of poor pilot proficiency in a non-nuclear mission proved true on the very first night of Arc Light. The bombing results were poor, the mission drew negative publicity for the Americans, and eight airmen lost their lives due to poor decision-making. Some components of the Arc Light 1 sortie resembled training scenarios flown by B-52 crews, but pilots demonstrated poor proficiency in the components that were different from what they were accustomed to seeing.

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[18] Harten, *Collision Over Vietnam,* 151.
[19] Head, "War From Above the Clouds," 18.
[20] Head, "War From Above the Clouds," 19.

SAC began planning for its first mission in Southeast Asia two days before the bombers took off. On 15 June 1965, reconnaissance assets discovered enemy forces approximately ten miles north of Saigon in a jungle near a Michelin rubber plant, away from civilian population.[21] Military leaders scheduled an air raid for 18 June. When they asked if they could use the B-52s for the strike, President Johnson demanded assurances from military leaders that no negative reaction and no civilian casualties would result from the raid.[22] SAC planners decided to launch 30 B-52Fs from Guam at 0100, fly to a rendezvous with in-flight refueling aircraft over the Philippines, and deliver their bombs over the target area at 0730 (Figure 8).[23]

Figure 8. Boeing B-52 Releasing Bombs
Source: National Museum of the US Air Force

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[21] Harten, *Collision Over Vietnam,* 147.
[22] Head, "War From Above the Clouds," 19.
[23] Head, "War From Above the Clouds," 19.

SAC's very first live combat briefing occurred in a large classroom on Guam, with 34 aircrews, 204 men, including the spare pilots and navigators. The speakers briefed the plan created in Nebraska using maps and butcher paper on makeshift easels. The plan called for thirty aircraft, divided into ten cells of three aircraft each. Planners named each cell after a distinct color.[24] Planners designated five different locations, separated by only twenty-five miles, as rendezvous points for the bombers and tankers. B-52 pilots were accustomed to in-flight-refueling points separated by fifty miles.[25] In addition, Typhoon Dinah had recently crossed the Philippines and was near the South China Sea changing the wind patterns. The briefing meteorologist told the crews they would experience a 100-knot headwind while flying towards the tankers. Finally, the brief informed crews that Brigadier General George Simler, Chief of Operations 2nd Air Division, would accompany the bombers to guarantee close command and control and that he would make the important decisions for all thirty bombers.[26]

Pilots began to make poor decisions before they approached the air-refueling tracks. Shortly after takeoff, Green cell executed an aircraft lead change. The lead aircraft lost his attack radar and changed positions with Green 2 so they could continue the mission. Green Leader could still employ weapons by flying directly behind Green 2 and dropping bombs off timing.[27] As the aircraft reached their cruising altitude of 30,000 feet, they discovered a 200-knot difference in the forecasted winds. Instead of a one hundred knot headwind, they experienced a one hundred knot tailwind, driving them to the rendezvous earlier. Three and a half hours into the flight, Green cell determined it was nine minutes early approaching its rendezvous point and the B-52 pilots decided to execute a 360-degree turn in order to kill time. Halfway through the turn, Green 3 collided with an aircraft from the Yellow cell and eight of the twelve crewmembers perished.

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24 Harten, *Collision Over Vietnam,* 147.
25 Harten, *Collision Over Vietnam,* 148.
26 Head, "War From Above the Clouds," 19.
27 Harten, *Collision Over Vietnam,* 156.

According to the co-pilot of Green 3, at least seven different decisions, made differently, would have prevented the collision.[28] Most of the decisions he identified as his own. Analyzing the scenario holistically, however, highlights poor decisions made by multiple pilots and planners. First, the SAC planners placed the rendezvous points twice as close as they should have been. If a B-52 travels at 450 knots and executes a turn at 25 degrees angle of bank, the aircraft's turn radius is almost 15 miles. That leaves little room for maneuver if two B-52 formations are executing turns in adjacent rendezvous points. Second, the SAC planners placed the bombers co-altitude. An easy de-confliction plan would have been to place the cells at different altitudes. SAC planners also failed to provide contingency-planning information on the maps issued to aircrew. The maps had no distances or timing between navigation legs; so pilots and navigators could not correct for wind changes and timing. Both the planners and pilots expected the mission to go "as-planned" and lacked foresight to prepare for contingencies, or provide the necessary information for contingency decision-making.

Regardless of the poor planning, Arc Light 1 pilots could have corrected the pre-planned decisions or made their own decisions to alter the course of events that night. The cells could have communicated with one another. Green Cell could have advised Yellow Cell that it was executing a turn to correct timing and de-conflicted flight paths between the two formations. The Green 3 co-pilot reports that he saw the beacon lights of Yellow 2 remain steady in the windscreen, a sign of impending collision, for some time before impact, yet did nothing to correct.[29] Before executing the turn, Green Cell could have closed their formation tighter to present less of a collision hazard to the other cells. Like many aircraft accidents, more than one decision could have prevented disaster.

Many contributing factors led to poor decision-making on 18 June 1965. SAC Headquarters planned a mission it had never executed. While aspects of the Arc Light mission were similar to Cold War nuclear runs over the Soviet Union, other aspects were new and different. The plans to strike targets inside the Soviet Union had existed for years. Headquarters adjusted or updated details in mission folders, but this evolution

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[28] Harten, *Collision Over Vietnam,* 149.
[29] Harten, *Collision Over Vietnam,* 160.

occurred over months and years, and decision-makers could discuss and debate changes. SAC Headquarters planned Arc Light 1 in just a few days. Some of the glaring errors include the positioning of aircraft and the lack of information presented to the aircrew. Thirty bombers comprised a large number of aircraft to place in a relatively small piece of sky for refueling, especially at the same altitude. Planners were accustomed to preparing mission details for much smaller formations, or formations spread out over greater distances.

SAC did not expect, or even desire, its B-52 pilots to be critical thinkers. Their nuclear mission was simple and straightforward. SAC desired pilots to fly the pre-planned route to the target without deviations and deliver their nuclear payload without asking questions. The organization wanted disciplined aircrew that followed each step of the checklist in a habitual manner. Such a philosophy may explain why planners did not provide timing-correction data to the aircrew in their Arc Light 1 mission materials. This organizational atmosphere also may explain why pilots did not ask for the data, or recommend an altitude de-confliction plan, or ask the "what if" questions regarding being early or late to the rendezvous points.

The twenty-eight remaining bombers on Arc Light 1 continued with the unsuccessful mission. Twenty-seven made it to the target because the twenty-eighth B-52 landed in Okinawa with a broken hydraulic pump and radar, not attributed to aircrew error or a poor decision.[30] The remaining B-52s reached the target area and released their payloads fifteen minutes ahead of schedule, guiding off a beacon placed in the target area the night before.[31] Fewer than half of the 1300 bombs hit within two miles of their targets.[32] A reconnaissance team inspected the target area and found no enemy bodies and little sign of damage. Intelligence officials later discovered that the enemy had fled the area before the attack.[33]

SAC Adapts

30 Head, "War From Above the Clouds," 19.
31 Head, "War From Above the Clouds," 20.
32 Head, "War From Above the Clouds," 20 and Michel, *The 11 Days of Christmas,* 13.
33 Head, "War From Above the Clouds," 20.

B-52 aircrew proficiency did improve after the first disastrous Arc Light sortie. With time, pilots gained experience and therefore improved proficiency in this more dynamic mission. Radar data of Vietnam improved, and SAC returned to radar-synchronous bombing on 2 August.[34] Aircrew returned to bombing targets using the tactic they practiced in training. B-52s began flying in smaller formations, similar to tactics they trained to employ against the Soviet Union. With time, the scenarios became more familiar, and recognition based on goals, cues, causal relations, and expectancies became easier. In January 1967, SAC Headquarters finally deployed a forward team for planning, the SAC Advanced Echelon (ADVON), which improved tanker coordination and planning overall.[35] The bombers also added additional forward bases to provide more options for B-52 deployments and staging.

In addition to the tactical, organizational, and planning changes, SAC also sought improvement through modifying the B-52 itself. The USAF modified 82 B-52Ds with the "Hi-Density Bombing System." This modification increased bomb payload capacity from 38,000 pounds to 60,000 pounds, but did nothing to improve aircrew situational awareness or decision-making.[36]

It is difficult to determine whether a return to familiar tactics or changes in planning and organization improved Arc Light mission success. The Headquarters Pacific Air Forces study accomplished in 1969 cites numerous field commanders and generals congratulating SAC and the B-52 crews for their work. Most of the bombing assessments are subjective, however, and measuring B-52 aircrew proficiency as a whole is difficult. The remoteness of the target areas and weather precluded most of the bomb scoring.[37] Few B-52 crews actually saw their targets. The bombers used photography on daylight missions to score bomb accuracy, but a majority of strikes took place in darkness or when clouds covered the target. General John P. McConnell, Air Force Chief of Staff in 1967, passed a "well done" to SAC and noted that more than 10,000 Arc Light sorties

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[34] Head, "War From Above the Clouds," 21.
[35] Project CHECO Southeast Asia Report. *USAF SAC Operations in Support of SEAsia,* 4.
[36] Head, "War From Above the Clouds," 22.
[37] Project CHECO Southeast Asia Report. *USAF SAC Operations in Support of SEAsia,* 30.

had expended 98.5 percent of their bombs on target.[38] It is unclear, however, from where General McConnell derives his assessment. Contrast his congratulations with World War II hero, retired Lt. Gen Pete Quesada, who performed a special fact-finding tour of Vietnam in early 1966. He said that the "B-52s were to a large extent bombing forests."[39]

The USAF Operations Analysis Office published a since declassified evaluation of B-52 bombing operations in Southeast Asia in August 1966. The report uses a metric of activity, referred to as "incidents," among the enemy units targeted by B-52s. The progress report states, "It is concluded that the analysis shows, for missions flown up to 20 January 1966, there is no statistically significant indication that the units responsible for the incidents have been adversely affected by the B-52 strikes."[40] According to the progress report, the B-52 strikes had little effect on their targets. This is not necessarily a direct indicator of B-52 crew proficiency because a poor strategy or resilient enemy are just two factors that could contribute to B-52 mission ineffectiveness, factors that do not relate to crew proficiency. The report simply states that through January 1966, the B-52 missions affected the enemy very little.

What is clear about the B-52 Arc Light mission is that initially, aircrew were not proficient at their assigned mission. The very first mission, Arc Light 1, is the most glaring example of poor decision-making. The mission presented many opportunities for crews to choose different courses of action. Beginning in the brief, they could have mentally projected those courses of action, analyzing what to do if the aircraft arrived early or late to the rendezvous point, determining what effect all of the aircraft flying at the same altitude would have, and identifying what communication needed to occur between cells to ensure de-confliction of aircraft.

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[38] Project CHECO Southeast Asia Report. *USAF SAC Operations in Support of SEAsia,* 36.

[39] Head, "War From Above the Clouds," 24.

[40] Operations Analysis Office, Vice Chief of Staff. *Evaluation of B-52 Bombing Operations in SEA (Southeast Asia), Third Progress Report.* HQ USAF, August 1966. Document is now declassified.

The SAC nuclear mission certainly contributed to the initially poor decision-making of B-52 crews in Vietnam. Crews struggled to make correct decisions in an operation much more dynamic than the rigid nuclear mission they trained to. The SAC culture formed an atmosphere of discipline oriented to following checklists, and the nuclear mission required pilots that executed almost without thinking. If national leadership decided to use the B-52s for their intended purpose, then the bomber pilots simply executed the plan. When the alarm went off, they followed the checklist as quickly as possible, launched the aircraft, followed a black-line on their navigation charts to a pre-determined target, employed their bombs using radar images from mission folders, and turned around to come home. The nuclear mission required very few decisions be made in a dynamic environment.

B-52 pilots were unprepared to deal with the fog and friction of war or deal with a reactive enemy or situation. The training they received taught nuclear aircrews to execute the plan as given because the nuclear mission allowed very little tolerance for deviations. Senior leaders and staff made most of the critical decisions in a community with a necessarily rigid command-and-control system. The aircrew simply executed many decisions made by others. When SAC then asked these disciplined, checklist-oriented crews to fly a mission similar to the one they were trained to accomplish, but one that required more decisions by the crews, they demonstrated poor proficiency.

In an attempt to improve mission success, SAC attempted to make the Arc Light missions resemble the nuclear mission that crews were accustomed to seeing, instead of improving the B-52 training program. For example, Arc Light formations decreased in numbers. To improve bombing accuracy, the organization quickly collected radar data on Vietnam so crews could return to the tactic of radar synchronous bombing. SAC also established permanent air refueling track locations and established standard air routes into and out of the target areas. These changes made the dynamic Arc Light missions more rigid and a closer semblance to the nuclear missions.

SAC did very little, outside of altering the mission planning, to improve aircrew proficiency during B-52 operations over Southeast Asia. It did not alter training or change the combat machine. Instead, SAC relied on the assumption that crews would improve in proficiency over time as they gained experience in the non-nuclear dynamic missions over Vietnam.

Conclusion

In the Cold War of the 1950s and 1960s, the US chose a strategy that required detailed plans and created bomber aircrew proficient in highly scripted scenarios. In order to get all the bombers to their pre-planned targets, SAC headquarters created detailed folders with all the forecasted information they believed crews would need to accomplish the mission. SAC taught crews to quickly and methodically follow checklists, fly the mission exactly as prescribed, and deliver their nuclear payload. The plan allowed very little dynamic decision-making, but instead relied on simple obedience, indicated by the fact that pilots stated they turned their brains off for many of the training sorties.[41] Leaders and planners at SAC headquarters made most of the required decisions for the aircrew.

The Arc Light missions required pilots and crews to make more decisions. Before B-52 pilots readied their aircraft for a mission over Vietnam, SAC planners did not hand crews mission folders with years of research and thought behind them, like they did for the nuclear missions. Minor differences between the nuclear missions and the Southeast Asia missions created more opportunities for B-52 aircrew to make decisions. Lack of training in the new scenarios, however, and a lack of practice in decision-making in general, led to some poor pilot proficiency. The RPD model illustrates the importance of familiarity when making decisions. The Arc Light missions violated expectancies and crews struggled to mentally forecast imagined actions. B-52 crews were not familiar with the environs or the consequences of their decisions. The very first attempt to employ B-52s over Vietnam, Arc Light 1, is an example of the difficulties aircrew faced.

In the final analysis, SAC made very little attempt to improve B-52 crew proficiency by adapting training or technology in Southeast Asia. SAC did attempt to make the Arc Light missions resemble the nuclear missions as much as was possible. It returned to radar-synchronous bombing as soon as radar data was available and it reduced the formation sizes to make them more closely match how pilots employed their aircraft

[41] Harten, *Collision Over Vietnam,* 20.

in nuclear war. The only change made to the aircraft itself was to increase conventional-bomb-payload capacity, a change that neither enhanced situational awareness nor aided in decision-making. B-52 crews did improve in proficiency as they gained experience in the conventional mission, however, their situational awareness improved with experience, which in-turn increased their recognition of scenarios based on goals, cues, causal relations, and expectancies, endowing them with increased capacity to make good decisions. It is difficult to measure how much B-52 crew proficiency improved throughout Arc Light, but any increase in proficiency was a result of two things: SAC altered the missions to make them resemble the nuclear training missions and crews gained experience as they flew more combat. SAC implemented no changes in training or human-machine interface to improve proficiency.

B-52 crews improved proficiency while flying combat missions, a format of on-the-job training. Not all pilots or operators have the same freedom. ICBM crewmembers do not have the opportunity to make poor decisions and use combat experience as a means to improve proficiency when the Commander in Chief asks them to execute their mission. The next case study analyzes the USAF's historical approach to ICBM crew training and how the introduction of a new training philosophy affected crew proficiency.

Chapter 3

Instructional Systems Development: ICBM Crew Proficiency in the 1970s

> *In war the experienced soldier reacts rather in the same way as the human eye does in the dark: the pupil expands to admit what little light there is, discerning objects by degrees, and finally seeing them distinctly. By contrast, the novice is plunged into the deepest night.*
>
> Carl Von Clausewitz

The US Air Force changed its training philosophy in the 1970s in an attempt to more effectively and efficiently create combat airmen. The changes incorporated a systematic approach that focused instruction in what teams of experts determined were the most relevant knowledge and skills. The new training also required students to be more active in the learning process. SAC first implemented the changes at the initial qualification training only, but after two reports indicated a need for improved proficiency, SAC also changed the training philosophy at the operational combat ICBM squadrons. The results were improved missileer performance. This chapter analyzes changes in training doctrine the Air Force implemented in the 1970s and how these changes affected missileer decision-making abilities.

Missileer Training Post-Vietnam

Missile Combat Crew Members (MCCM) have a tremendous responsibility. When the Commander in Chief calls upon the men and women operating the missile command rooms, buried deep in the ground spread across the nation, they must be proficient at their job. The nation depends on them to make correct decisions expeditiously. The mission not only requires missileers to be proficient at employing nuclear intercontinental ballistic missiles, but also demands they know how to safeguard the system and resolve malfunctions of the same dreadful weapons they could one day employ. Keeping these missiles safe requires a high level of situational awareness and proper decision-making. The Air Force has successfully trained missileers to competently perform the nuclear mission for more than 60 years.

Missileers' job includes both dull routine and sheer excitement. They operate 65 feet underground in a 162-square-foot missile-launch capsule enclosed by an eight-ton steel door (Figure 9).[1] The crews may rarely see or touch the weapons they could employ because the missile silos are often miles from the command room where they work. The job requires mastering an exhaustive series of checks and procedures. MCCMs must be proficient in not only launching their assigned nuclear weapons under stressful situations, but they must also be capable of diagnosing problems and taking corrective action in emergencies. Missileers, however, spend much of their duty time waiting for an order to act. Extremely long working shifts lead to hours that the crewmembers do not directly engage in the mission or training.

Figure 9. Procedure Trainer for the Minuteman II Missile
Source: National Museum of the US Air Force

Origins of MCCM training begin in World War II. Weapons system technology advanced rapidly during World War II, creating both benefits and problems. The advanced technology gave the nation advantages over adversaries on the battlefield but it

[1] James Atwater, "How the Modern Minuteman Guards the Peace" *Saturday Evening Post* 236, no. 5 (February 1963): 66 and Nathan Hodge and Sharon Weinberger, "The Ever-Ready Nuclear Missileer." *Bulletin of the Atomic Scientists* 64, no. 3 (July/August 2008): 14.

also created problems in managing, operating, and training. To solve problems created by rapidly advancing weapons technology, designers and managers created a methodology known as "The Systems Approach," or systems analysis.[2] The systems analysis breaks a difficult problem into three steps. First, a group of experts identifies all components of the problem and the relevance of each component. Then, they use models to simplify the complex problem. Finally, the first two steps allow the group to design a unique method to solve the problem that is "as systematic as the problem will allow."[3] A systems analysis is nothing more than a well educated guess to the solution of a complex problem.

In the 1960s, experts began to see training in aviation as a complex problem that a systems-analysis approach may simplify and improve. In systems-analysis, subsystems and their interfaces comprise the whole system. Some individuals saw training as a subsystem and part of a larger operational whole. A systems analysis applied to training, known as Systems Approach to Training (SAT), later designated Instructional Systems Development (ISD), attempted to optimize the process of both the total operational system and the training subsystem. During the late 1960s and early 1970s, planners codified instructional design procedures and "models prescribing specific sequences of training development emerged."[4] These became known as SAT and ISD. Just like instrument flight in the 1930s, the commercial industry led the military in training innovation. American Airlines was the first to apply a Systems Approach to Training in how it trained pilots.[5]

Eventually, external factors influenced the Air Force to assess its training doctrine and implement changes. In the same time-period that the commercial airlines began to use SAT to train pilots, the Air Force was deeply involved in Vietnam and struggling to find strategic success. Meanwhile, the American public grew less enthusiastic about the

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[2] Department of the Navy, Ins*tructional Systems Development: Conceptual Analysis and Comprehensive Bibliography*, Technical Report: NAVTRAEQUIPCEN IH-257. (Orlando, FL: Naval Training Equipment Center, February 1976), 9.
[3] Ins*tructional Systems Development: Conceptual Analysis and Comprehensive Bibliography, 9.*
[4] "Guy J. Fritchman, "Instructional System Development at Operational Missile Units" (Masters Thesis, Air Force Institute of Technology, September 1985), 3.
[5] "Instructional System Development at Operational Missile Units," 18.

war in Southeast Asia, and political decisions followed the will of the people. In 1971, the Nixon administration announced that it would end the draft.[6] The Air Force knew that Congress would soon downsize the service and ask airmen to do more with less. This was especially critical in the ICBM community where the mission of nuclear deterrence remained as strong as ever and no downsizing in weapon numbers occurred. SAC still required missileers to command and safeguard 1054 missiles.[7] The Air Force believed it could create more efficiency in training to compensate for the loss in manpower. Shortening the training pipeline could reduce training and personnel costs. In January 1970, Air Force Chief of Staff General John D. Ryan issued direction to his major commands concerning training methods, "To make dramatic increases in efficiency requires that we be innovative and have a willingness to depart from traditional methods."[8]

Tactical Air Command was the first command to respond to the Chief's direction. In February 1970, it initiated a Systems Approach to Training for the A-7D. It was the first complete weapons-system-training program based entirely on the SAT or ISD concept. After implementation, a report stated, "The results of the A-7D program justify the revision of all major flying training programs using the ISD concept."[9] The Air Force saved an estimated $43,000 per student in the A-7D training program.[10] Tactical Air Command assembled an ISD team to re-vamp all formal training of its weapon systems and it was not long before SAC followed suit in training ICBM missileers.

Instructional Systems Development

Michael Hays states that Instructional Systems Development "is the closest thing the US Air Force has to an official training doctrine."[11] ISD was the result of evolving

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[6] Allan R. Millett and Peter Maslowski, *For the Common Defense: A Military History of the United States of America* (New York, NY: The Free Press, 1994), 597.
[7] *For the Common Defense: A Military History of the United States of America,* 596.
[8] Major General Oliver W. Lewis, "Simulation: The New Approach," Air University Review, March/April 1974.
[9] Tactical Air Command Headquarters, *TAC Programming Plan 23*-72: *Instructional Systems Development/Systems Approach to Training (ISD/SAT)* (Langley AFB, VA:, 16 October 1972), 1.
[10] Michael D. Hays, *The Training of Military Pilots: Men, Machines, and Methods* (Maxwell AFB, AL: School of Advanced Airpower Studies, 2002), 25.
[11] *The Training of Military Pilots: Men, Machines, and Methods,* 20.

education and training philosophies in the 1950s and 1960s. In general, ISD is the passage of specific knowledge to designated students, rather than the dissemination of knowledge for its own sake. Robert Gagne, one of the original ISD theorists at Florida State University, states, “The purpose of all ISD models is to provide a conceptual framework into which compatible procedures can be integrated to produce effective and efficient instruction.”[12] It is an orderly, but flexible, process for planning, developing, and implementing instruction with a goal to increase effectiveness and efficiency in training.[13] When applied correctly, ISD fits instruction to jobs, eliminates irrelevant knowledge from courses, and ensures that students acquire the necessary skills, knowledge, and attitudes to do the job.[14]

The first Air Force publication that outlined ISD was Manual 50-2, Instructional Systems Development. The original Air Force model organized the ISD functions into five basic steps: Analyze System Requirements; Define Education and Training Requirements; Develop Objectives and Tests; Plan, Develop, and Validate Instruction; Conduct and Evaluate Instruction. Planners designed the entire process to be iterative, with feedback and dialogue from any single step potentially affecting the other four. Figure 10 is an illustration of the original Air Force ISD model.

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[12] Robert M. Gagne, *Instructional Technology: Foundations* (Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers, 1987), 402

[13] Air Force Manual 36-2234, *Instructional System Development,* 1 November 1993, 106.

[14] Air Force Manual 36-2234, 7.

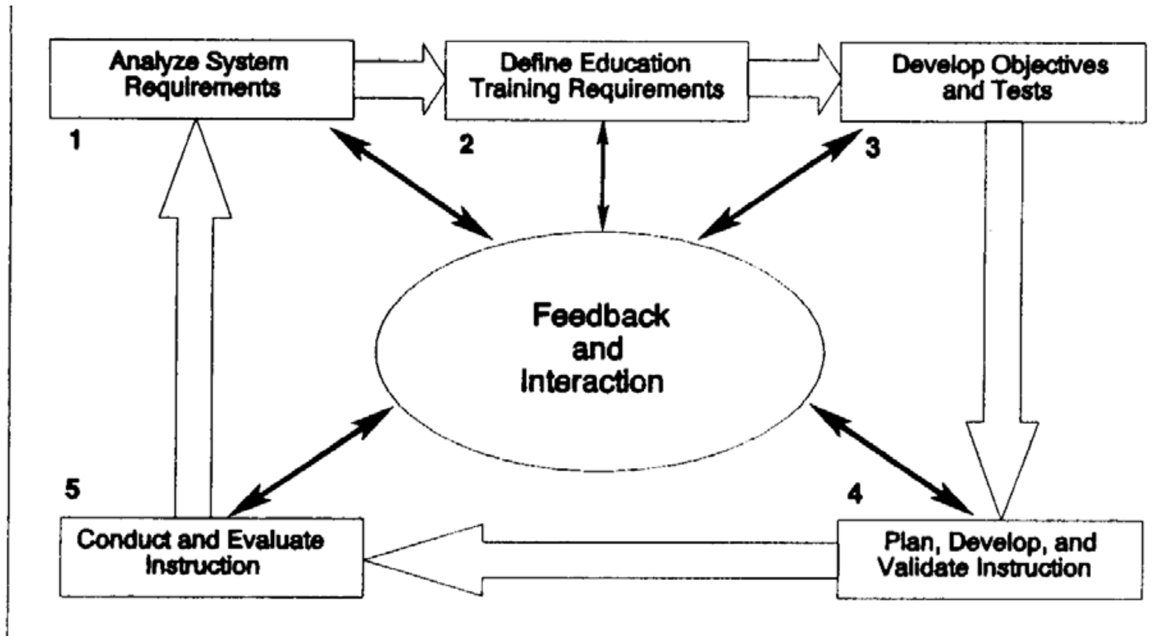

Figure 10. Original Air Force ISD Model
Source: AFMAN 36-2234

Step 1 and Step 2 of the Air Force ISD model set a foundation for the training process. Step 1, Analyze System Requirements, involved occupational, job, and task analyses. Ideally, a team of experts in the analyzed job combined with trained ISD professionals accomplished this task. The product was statements of behavior, conditions, and standards for task performances. Not until Step 2, Define Education and Training Requirements, did the group even determine if the job required training. Step 2 defined a selection of tasks for instruction based on factors such as criticality, learning difficulty, and frequency of performance.[15]

In addition to the five steps listed, three pillars of ISD distinguished the training doctrine from previously employed training methods. First, ISD was a systematic approach. An ISD team attempted to develop a process and framework by which instructors could train students in a systematic manner. Second, ISD encouraged, even demanded student involvement. It attempted to capture the strengths of the 5th Century Socratic method to get the trainee involved in the learning process. Learning within the ISD model was not a passive process, but instead demanded that a student remain engaged through testing, individual instruction, simulators, other media devices, and

[15] Air Force Manual 36-2234, 9.

continuously demonstrating performance. The systematic process forced the student to maintain situational awareness and make decisions throughout the learning process and ISD gave students more opportunities to fail and learn from poor decisions. Finally, planners based the ISD model on self-pacing and flexible instruction timelines to allow for different learning rates.[16] Emerging technology in computers and simulation in the 1970s began to make this possible without individual instructors for each student. Course developers designed computer-based training, videos, and simulators to present trainees with dedicated training that students could accomplish at their own pace.

ISD in Initial Qualification Training – Phase 1

The Air Force implemented the ISD model at Vandenberg Air Force Base first in the early 1970s. Vandenberg served as the "schoolhouse" to provide Missile Combat Crew Members their initial training. The 4315th Combat Crew Training Squadron (CCTS) executed all the ICBM initial qualifications as well as their own in-house instructor-training programs. The squadron had a dedicated Education and Training Officer to help implement and update training. Lt Col Roderic Gale served as the 4315th CCTS Training Officer from 1973 to 1977. When he showed up in 1973, SAC had already directed the 4315th CCTS to use ISD to revise the existing training courses and use ISD in the development of any new training courses.[17] The 4315th had already created an ISD Branch in which experienced missileers worked through ISD Steps 1 and 2: Analyze System Requirements and Define Education and Training Requirements. Gale joined them in Step 3, Writing Objectives and Tests. In Lt Col Gale's opinion, "The missileers' use of ISD Steps 1 and 2 had been done comprehensively and carefully in-line with the ISD model."[18] The ISD branch included the Training Officer, experienced MCCM instructors, and enlisted personnel who, "supported aspects of the projects, such as writing computer programs used in the simulators, producing audio-visual materials used in classrooms and learning centers, and assisting the project managers and their teams of crew subject matter experts as they moved through the ISD steps."[19]

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[16] Keith Geiger and Donald Moody, "Problems in Instructional System Development," Air University, May 1977, 17-19.
[17] Roderick A. Gale, Lt Colonel, USAF, Retired, to the author, e-mail, 20 March 2016.
[18] Gale to the author, e-mail.
[19] Gale to the author, e-mail.

Through careful analysis, the 4315th ISD Branch developed a slightly shortened initial MCCM training course. The ISD model helped the team narrow the focus of training and create a course that taught less technical knowledge than the previous course. The new syllabus no longer required students to understand the "why" behind every technical system or malfunction. Trainees no longer had to use colored pencils to trace the flow of electrons or fuel molecules through the electric or fuel systems of the ICBMs or command and control network.[20] Nevertheless, they did have to understand the checklist procedures, what those procedures entailed, and when to apply them. The ISD Branch identified specific learning objectives based on what missile combat crews actually needed to do. They could then develop specific job-related criteria for missile combat crews, "including describing observable actions and behaviors and establishing metrics defining various levels of performance and competency."[21] The process helped focus and shorten the training pipeline. Dr. Raffield, an instructor with the 4315th, described the changes in training, "We streamlined our training by removing as much of the 'nice to know' material as we ethically could."[22] Applying the ISD model to initial qualification training helped the 4315th focus instruction on what missileers needed to know most to execute their future mission.

ISD at the Operational Combat Squadrons – Phase Two

The Air Force, in an attempt to improve training efficiencies, emphasized ISD at the formal training units, but neglected implementation of ISD in the operational units. The operational bases received little guidance on how to use ISD in training.[23] Similar to flying units, training at the operational ICBM units was important because a missileer showed up to a combat squadron with the minimum knowledge and decision-making skills required to operate the weapon system. Continuation Training (CT) in the operational squadrons was more important than ever when the 4315th began utilizing an efficient instructional system specifically designed to teach individuals the knowledge and skills needed to be MCCMs at minimum time and cost.[24] The combat squadrons

[20] Charles Simpson, Colonel, USAF, Retired, to the author, e-mail, 9 March 2016.
[21] William D. Raffield, PhD, to the author, e-mail, 18 March 2016.
[22] Raffield to the author, e-mail.
[23] "Instructional System Development at Operational Missile Units," 18.
[24] "Instructional System Development at Operational Missile Units," 3-4.

needed to add the "graduate-level" training to the efficient undergraduate training missileers received at Vandenberg.

Just as they do with pilots, the Air Force expects Missile Combat Crew Members to grow in knowledge and decision-making abilities while they execute their assigned mission. Initial qualification training provides a foundation to build upon. Under the ISD concept at Vandenberg, instructors taught enough technical details of the ICBM weapon system to allow students to execute the checklist, including emergency procedures. Students needed to know how to diagnose a problem and how to take corrective action. They had to make decisions regarding the employment, health, and status of nuclear weapons. Nevertheless, the Air Force offered no more training to the initial qualification students than what was required. The expectation was that operational combat squadrons would build on the foundation established at the 4315th.

Through the 1970s, the operational combat squadrons provided monthly continuation training to all missileers. The squadrons required crews to satisfactorily complete self-study packages for all MCCMs to accomplish at launch facilities, several hours of classroom weapon system training, four hours in a simulator training ride, and several hours of "Emergency War Order" training each month to remain certified.[25] The simulator, or Missile Procedures Trainer (MPT), was an exact replica of the Launch Control Center. The MPT provided a medium for realistic, hands-on experience for procedures that the crews could not perform regularly at the launch facility, yet were essential to mission accomplishment.[26] For obvious reasons, missileers could not practice all the procedures leading up to the key-turn in an active facility. Training in the MPT included scenarios in emergency procedures and missile launch. The squadrons conducted as much of the Emergency War Order training as was reasonable at the actual Launch Control Centers so crews could practice the exact combat procedures, in the actual combat environment, short of actually launching a weapon. The squadrons accomplished all of this training, however, without applying the ISD model.

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[25] Raffield to the author, e-mail and Danny Cochran, Major, USAF, Retired, to the author, e-mail, 11 March 2016.

[26] "Instructional System Development at Operational Missile Units," 25.

Two events instigated training changes at the operational units. In 1977, the USAF Inspector General criticized SAC for not applying ISD at the operational unit training programs.[27] Then, in 1979, a SAC report identified a decline in crewmember proficiency. It pointed to "ineffective training programs" and recommended a renewed emphasis on ISD at the operational units.[28] That same year, an ICBM working group formed to develop comprehensive performance objectives (CPO), a realistic set of tasks and subtasks required of crew members, the conditions under which they were to be performed, and the expected standard of performance.[29] The working group essentially accomplished Step 1 and 2 of the five-step ISD model. Figure 4 illustrates one example of the objectives, required conditions, and expected standards format. A formalized objective, conditions, and standards allowed instructors to standardize and focus the training they provided in the classroom, simulators, and launch-control facilities. They spent no additional time training, but rather focused on the tasks identified by the working group as the most relevant for training.

27 "Instructional System Development at Operational Missile Units," 19.
28 "Instructional System Development at Operational Missile Units," 20.
29 "Instructional System Development at Operational Missile Units," 21.

D06 Perform Security Alarm Situation Checklist		LEVEL 4 4 4 4
PERFORMANCE	**CONDITIONS**	**STANDARDS**
	Given T.O.-1, SACR 207-17, SACCEM 2-25, local directives, and under one or more of the following conditions:	C O B M
1. Recognize requirement to accomplish task	1. Alarm indications 2. Non-alarm indications a. IAW T.O.-1, fig 5-1	4 4 4 4 (within 3 minutes of status presentation)
	b. IAW SACR 207-17	4 4 4 4 (Within 5 minutes of status presentation)
2. Direct/process checklist actions a. Through step 2		4 4 2 2 (As stated in performance #3)
b. After step 2		3 3 2 2
3. Configure equipment and verify indications	1. CCBV a. Closes remotely	4 4 2 2 (within 1 minute after C/L initiation)
	b. Closes manually	2 2 4 4 (within 5 minutes after C/L initiation)
4. Notify agencies/personnel		3 3 2 2
5. Reconfigure equipment and exit C/L	1. A.R.T. investigation terminated	3 3 3 3

Figure 11. Sample CPO for a Titan Unit
Source: "Instructional System Development at Operational Missile Units"

Results of ISD

It is difficult to provide a metric demonstrating that implementation of ISD increased ICBM crews' situational awareness and decision-making abilities. Neither the Air Force nor SAC produced reports on the effect of ISD on crew proficiency. Even the instructors that directly interacted with the crews and performed their continuation training provide differing opinions on the benefits of ISD. The majority of the instructors and crew evaluators, however, believe that ISD had a positive effect on MCCM proficiency.

Introducing ISD created specific benefits. First, ISD reduced training time. With established objectives on the realistic set of tasks and subtasks, in the conditions under which crews actually performed tasks, and with set standards of performance, instructors could execute training in a more efficient manner. Shortening training also reduced costs. Training costs for the Air Force peaked in the early 1970s and then continued to drop through 1979.[30] Purchasing simulators and other training media to implement ISD training methods may account for the initial rise in training costs in the first part of the decade. Student quality also improved. According to Geiger and Moody, the general consensus at the time was that the "student-centeredness of ISD promotes improvement in student performance, motivation, and learning rates."[31]

Finally, ISD provided flexible guidelines for instructors. The model guided instructors through a systematic but flexible process that enabled instructors to develop training programs in an orderly fashion. ISD-based training programs were no longer dependent on the instructor's opinion of what the student needed to know but relied instead on mission requirements.

The training better prepared students to make decisions in combat because they trained in an environment that the institution, as a whole, decided was relevant, as opposed to an individual instructor.[32] Rather than one individual instructor identifying the training objective and environment for the student, the entire system of experienced instructors and experts selected the training conditions. When it came time to make the combat decision, students would be in an environment that was familiar because they already experienced the scenario in training. Familiar goals, cues, causal relations, and expectancies would bring recognition to missileers when they needed it most. The recognition would then allow them to run the scenario to a logical conclusion in their minds and make the correct decisions to achieve success.

The ISD model also carried potential negative consequences. The process to develop the training programs was extensive. Step 1 and Step 2 in the five-step model took the 4315th ISD Branch months to accomplish. The operational units did not accomplish the same steps until prompted by negative reports, years later. The combat squadrons focused on the mission and did not apportion personnel to accomplish such a

30 "Instructional System Development at Operational Missile Units," 31.
31 Keith Geiger and Donald Moody, "Problems in Instructional System Development" (Maxwell AFB, AL: Air University, May 1977), 63.
32 Gale to the author, e-mail.

time-intensive task. ISD was systematic and required procedural knowledge to execute. Insufficient knowledge of the process could lead to incorrect emphasis or overemphasis, selecting the wrong training media, and a lack of proper evaluation.[33] This problem compounded when the military experienced continued turnover among experienced instructors. Finally, while technology and media enhanced training, they also compounded the ISD process. As technology changed, the training model had to keep up. If a weapon system experienced a change in software or upgraded systems, the media used to train personnel on that weapon system must also change. The simulator was most useful when it matched the actual system used in combat. If the combat system and the simulator did not mirror each other, then trainees could experience negative learning. The goals, cues, causal relations, and expectancies experienced in the simulator may not resemble those experienced in the combat system. This could potentially cloud the scenario, prevent recognition, and lead to poor decision-making.

Some instructors complained that the level of disseminated knowledge under ISD was insufficient. SAC was "checklist focused" and "missile combat crews had no discretion or authority to deviate from established SAC procedures."[34] The senior crewmembers and instructors, however, knew from experience that not every scenario was a "textbook" situation. Those scenarios required sound decision-making based on experience and a deeper knowledge level than that provided through the ISD model. Nevertheless, the same instructors also understood that a student did not receive all knowledge during the initial qualification course and that the operational combat squadrons held the responsibility to build on the foundational knowledge received at Vandenberg.

ISD was a more focused training regimen, but the training goal behind ISD was to efficiently create adaptable operators. From AFMAN 36-2234, "It is clear any new model of the ISD process should reflect movement away from rigorously applied procedures and emphasize adaptability to changing environments."[35] The emphasis on scenarios, rather than events, and information most relevant to the job, rather than pure

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33 "Instructional System Development at Operational Missile Units," 32.
34 Raffield to the author, e-mail.
35 Air Force Manual 36-2234, 10.

knowledge, created operators who were better equipped to make decisions, even in dynamic environments.

Instructional System Development in the ICBM mission did create a more active student body. It promoted active student involvement. The process forced MCCM to be engaged in self-learning, forced them to maintain situational awareness, and forced them to practice active decision-making. Students could no longer sit in a classroom and turn their brains off. They went through more individualized training with electronic media, used simulators in scenarios, and participated in more evaluations. ISD provided more opportunities for students to practice necessary behaviors, as identified by Steps 1 and 2 in the model. ISD also ensured students demonstrated accomplishment of the behaviors under the exact conditions and standards required to perform outside of the training environment.[36] This was extremely important for missileers because some behaviors of the mission they would only perform if asked to turn the key and participate in nuclear war. They could not gain experience through launching an intercontinental ballistic missile, but instead relied on focused training in an environment made as close to combat as possible. ISD helped improve situational awareness and decision-making in a mission that no crews had ever actually accomplished.

Some instructors attributed improvement in situational awareness and decision-making to other factors. Perhaps because new missile crewmembers arrived at the combat units with less technical knowledge, the experienced crews emphasized more personal study and encouraged newer crewmembers to study more in an effort to improve their situational awareness, analysis, and decision-making. As the weapon system aged, the Air Force made technical information more available to the crews for their own study. Some crews took advantage of this material while others did the minimum to remain combat-qualified. Referring to situational awareness and decision-making, Dr. Raffield believes that, "Individual motivation and interests were a bigger factor in developing these skills than training-system expectations."[37]

When asked if ISD improved decision-making among missile crewmembers, Donald Wolfe responded, "It did, but the use of more sophisticated simulators clouded

[36] "Instructional System Development at Operational Missile Units," 2-3.
[37] Raffield to the author, e-mail.

the issue. It was hard to tell whether it was the precepts of ISD, for example, self-pacing, student orientation, hands-on, etc., or the advantages of increased technology and better, more realistic simulators, that made the difference."[38] Don Boelling provided a similar response and said that the improvements in the simulators created better decision-making. He said, "Crews seemed to be more confident in their decisions."[39] Crews may have gained confidence in decision-making because they could execute entire checklists in the simulator and experience scenarios in conditions very similar to what they would expect to see in the actual Launch Control Center. Certain aspects of ISD, such as the emphasis on training media and simulators that were more realistic, certainly enhanced crew situational awareness and decision-making.

Instructional Systems Development created more changes in ICBM initial-qualification training than it did in operational squadrons. When Air Force leadership and SAC pushed ISD down to its units, the change in training doctrine affected the 4315th much more than it affected combat operations. A formal training unit's primary mission is training. A combat unit's primary mission is combat or combat readiness. The combat unit is always in combat or preparing and maintaining readiness for combat. A missileer's job is to maintain nuclear equipped missiles on constant alert in preparation to launch upon the Commander in Chief's orders. The ICBM squadrons execute the mission 24 hours a day, 365 days a year, and training is an additional duty. It is somewhat understandable that the operational units were slow to transition to ISD when their focus was more on the mission than training. If a commander and instructors believed their crews were proficient, there was no impetus to adopt new training methods. The operational units required two negative reports before they implemented ISD training methods. Yet, when they did take the time to perform Step 1 and Step 2 of the five-step model, "analyze system requirements and define education and training requirements," the community saw improved situational awareness and decision-making skills among its crewmembers.

Perhaps the greatest benefit of ISD was student activity. Under traditional training methods in the 1960s, students played a more passive role in learning. They

[38] Danny Cochran, Capt, USAF, Retired, to the author, e-mail, 12 March 2016.
[39] Don Boelling, to the author, e-mail, 12 March 2016.

spent much of the course sitting in academic classrooms as a group and digesting academic knowledge. In contrast, ISD emphasized individual training and student involvement. Trainees spent more time in sophisticated simulators that more closely resembled the combat conditions in which they would make decisions. The systems approach forced students to be aware of the environment, anticipate the future, and make decisions. If the decisions were incorrect, the student received feedback without mission consequences because it took place in training as opposed to real combat. ISD, and the emphasis on student involvement through media and simulators, created ICBM crewmembers better prepared to make decisions in a stressful operational environment.

Conclusion

SAC changed training doctrine in the ICBM community when it adopted Instructional System Development in the 1970s. ISD forced a more focused and systematic approach to training at the initial qualification course at Vandenberg AFB. The five-step ISD model created a more effective and efficient training course as students became more active in their learning, and instructors taught to specific objectives. The reformed course required students to maintain higher levels of situational awareness and practice making more decisions than before. Later, ISD focused training at the operational combat units. When the combat squadrons eventually accomplished Step 1 and Step 2 of the five-step model, they were able to realize training in an environment and scenarios that more closely resembled the actual conditions in which situational awareness and decision-making would be required. The focused training enabled crews to recognize more readily the scenario based on goals, cues, causal relations, and expectancies, illustrating the importance of scenario recognition and experience in the RPD model. The recognition improved situational awareness and decision-making.

Conclusion

No general can accustom an army to war. Peacetime maneuvers are a feeble substitute for the real thing; but even they can give an army an advantage over others whose training is confined to routine, mechanical drill.

Carl Von Clausewitz

In 2011, the MQ-1 squadron tasked with missions in Libya spent almost a month in dedicated training to prepare for Operation Unified Protector. For the missions they would be flying in Libya, pilots had received two introductory training sorties while attending their initial formal training in the Predator. Some of these pilots had flown familiarization sorties two years before and had not discussed or seen a similar mission since then. The squadron prepared for the unfamiliar missions with focused academic training and discussions, but still measured their own proficiency less-than-adequate until they flew the first combat missions of Operation Unified Protector. Pilots struggled on the first few sorties in Libya, and the initial clumsy performances do not resemble the successful missions flown in the latter half of the operation. Proficiency was important because the pilots ended up employing hundred of missiles, designating targets for other NATO aircraft, and protecting anti-Qaddafi rebels from the pro-Qaddafi regime.[1] Why were MQ-1 pilots not better at decision-making? How could the Air Force and the multi-role RPA community have produced pilots with better combat decision-making skills? What could policy makers have done to foster better combat decision-makers? Through a contemporary and historical lens, this paper analyzes crew proficiency and decision-making.

Four main factors contribute to the proficiency problem among MQ-9 pilots. First, the cockpit of the MQ-1 Predator and MQ-9 Reaper was not designed for combat aviation. The cockpit does not present information or allow for aircraft control in the most effective and efficient manner for combat decisions. Second, the high demand for multi-role RPAs on the battlefield requires nearly all the time and energies of all qualified pilots. There is little time to train and practice decision-making. Third, the insatiable

[1] Unattributed interview with MQ-1 instructor pilot involved in Operation Unified Protector, 5 January 2016.

demand for RPAs caused the community to grow very quickly. The USAF has not taken time to assess the quality and quantity of training in relation to long-term goals and objectives. Lastly, the current training procedures that do exist are not scenario-based. When pilots creatively find time to train, they focus on events rather than scenarios.

In the past, all multi-role RPA pilots were experienced and came from other Air Force aircraft. They were developed aviators, many from strike aircraft who brought their experience and skills to a new weapon system. They had witnessed and participated in scenarios in their previous aircraft similar to the ones they would see and experience flying an MQ-9.

Today, however, the majority of MQ-9 pilots are young, inexperienced aviators with little combat training or experience. Rather than moving experienced pilots from other aircraft into an MQ-9 cockpit, the Air Force now trains officers with no previous aviation experience to fly the Reaper. In order to produce more RPA pilots at lower cost and in a shorter time-period, the Air Force initiated Undergraduate RPA Training. URT introduces student pilots to all the varying mission types they may see in the future. Nevertheless, the course provides pilots only an introductory and initial experience to the future combat scenarios they may execute shortly after graduation.

All Air Force pilots must be capable and sound decision-makers, especially during combat. The many decisions they make on a regular basis lead to mission success or failure and often determine life or death. Multi-role RPA pilots are not exempt from this requirement, and the consequences of an MQ-9 pilot's decisions are significant. Combatant Commanders and National Command Authorities often task Reaper pilots with very consequential missions. The aircraft's unique capabilities of long endurance, high-quality sensors, high precision munitions, connectedness to the intelligence community, and low risk to crew life, make the weapon system ideal for some very important missions. The consequences of success or failure of such missions can be severe. The intelligence community, friendly ground forces, other air assets, combatant commanders, and National Command Authority all depend on MQ-9 pilots to make good decisions.

The Recognition Primed Decision (RPD) model explains how a pilot determines a course of action when presented with a time-constrained decision. Pilots do not make decisions by comparing and contrasting the consequences of different courses of action. Instead, they make decisions based on recognition of the situation and their own experience in goals, cues, causal relations, and expectancies. If the situation is not familiar or it is unrecognizable, pilots struggle to make the best decision possible. Understanding the RPD model helps explain success and failure in decision-making of past pilots and missileers, and helps illuminate potential improvements to RPA pilot training.

Although technology has changed the characteristics of war, airmen throughout history have had to make impactful decisions in time-critical situations with complex weapon systems. This paper examines the combat airman's decision-making process in the Air Mail Fiasco, B-52 employment during Arc Light in Vietnam, and Instructional Systems Development in ICBM crew training. All three case studies provide insight into crew proficiency and different approaches to improve situational awareness and decision-making.

Failure in 1934 Creating Combat Aviators for World War II

Public failure in delivering the nation's mail in 1934 led to US Army Air Corps policy changes in the short-term, as well as equipment, manning, and doctrine changes in the long-term that ultimately created more proficient aviators in World War II.

In the winter of 1934, the US Army Air Corps lost twelve airmen due to poor decision-making. At the time, military and civilian leaders based their perception of aviation in future conflict on how airmen employed their weapons in World War I. Pilots flew combat aircraft only in good weather. The technology that enabled pilots to maintain situational awareness in bad weather and at night existed, even though the Air Corps chose not to use it. The Air Corps failed to equip aircraft with the necessary tools to orient and navigate in bad weather, or train military pilots to use the equipment.

Accident rates were high during the Air Mail Fiasco for two main reasons. Many cockpits did not present information in a format pilots could use, and pilots did not know what to do with the correct information, even when they possessed it. In 1934, Air Corps pilots lacked situational awareness once they could no longer see the ground. Instruments did not work properly or were not present in many of the open-air cockpits.

Even when aircraft did have proper instrumentation, the Air Corps had not trained most of its pilots in how to read the data to determine aircraft orientation and navigation.

The highly publicized deaths and nature of the Air Mail Fiasco instigated change in the Air Corps. In the short term, General Foulois changed operational policy. He gave three specific orders: personnel would check all cockpit instruments to ensure proper functionality, only pilots trained and familiar with instrument flight would participate in Air Mail operations, and flights would take place only in good weather when pilots could see the ground.

Congress and the Air Corps also took long-term steps to fix the pilot-proficiency issues. They increased the organization's budget, updated aircraft and instruments, increased manning, emphasized operational training, and began to use simulators. Leaders required all Air Corps pilots to accomplish an additional ten hours of training per month. Even though pilots had completed their initial qualification training, the organization recognized the importance of continuation training and making sure pilots were recently familiar with the scenarios they would expect to see in combat operations.

The Air Corps adopted the first organizational use of flight simulators because of the Air Mail Fiasco. The Link Trainer became a key resource in training new student pilots and providing continuation training to more experienced pilots. The simulator provided a consequence-free environment for students to experience scenarios and make decisions. If their decisions were incorrect and resulted in unacceptable consequences, the instructor and student could analyze the level of situational awareness, then identify different courses of action. The simulator afforded the student another opportunity to see the scenario again and execute an alternative course of action. If the subsequent decision was acceptable, students now had a familiar scenario to cognitively assist them in future decision-making. If the "real-life" scenario was familiar to the simulated scenario and the student could recognize goals, cues, causal relations, and expectancies, then the pilot was more likely to make the correct decision. Organizational use of the simulator in training improved pilot decision-making.

The first military aviation simulator did have limitations. Its creator, Ed Link, recognized the Link Trainer was only a supplement to live-fly training. Technology limited the machine's ability to emulate the actual scenarios a pilot would experience in flight. Continuity in training was important, and the single format of the Link Trainer could not realistically simulate all the different kinds of cockpits that existed in 1934. Despite recognized limitations, however, the simulator proved to have a lasting impact in developing pilot proficiency.

The US Army Air Corps' mistakes and associated solution in 1934 provide insight into combat decision-making and training. First, Air Corps leaders and pilots were slow to recognize instrument flight as a necessary skill in military aviation. These men looked backwards to World War I for their cognitive image of aerial combat. When failure forced adaptation, Air Corps leaders made changes to both the machine and training process. Before the Air Mail Fiasco, the information provided to pilots via their cockpits was inadequate for decision-making and required the addition of instruments to enhance situational awareness. The Air Corps also increased the quantity of monthly operational training for each pilot. The organization mandated that pilots participate in regular training to maintain proficiency in their aviation skills. Lastly, the Air Corps learned the utility of aviation simulators in gaining and maintaining pilot proficiency.

The Air Mail Fiasco case study does not address some important topics regarding combat decision-making. In 1934, Air Corps pilots were not directly involved in combat. Their decisions were time-constrained and stressful, but did not involve weapons employment or the taking of human life. The consequences of their decisions, however, did include potential danger and death—the pilot's own life was at stake. This consequence is because the Air Corps pilots inhabited their vehicles, which inextricably tied the fate of pilots to that of their war machine.

The changes in training and cockpits instigated by failures in 1934 eventually created pilots better prepared for World War II. Pilots learned better to use information provided from the machine to enhance situational awareness and make time-critical decisions.

Practice in Decision-Making

The Arc Light case study illustrates the importance of *practice* in decision-making. B-52 crews in the 1960s intensely trained to deliver nuclear bombs over Soviet Union targets. SAC bomber aircrews were very disciplined and proficient at their nuclear-deterrent mission. They were experts in sitting alert, flying long endurance

Chrome Dome missions over the Arctic, and training to navigate specified routes into enemy territory. When the mission presented them with a slightly different scenario that required decision-making in a more dynamic environment, however, the crews struggled to determine the most correct course of action. The aircrews lacked practice in making decisions based on changing inputs. They were accustomed to automatically following pre-determined mission plans and executing scripted checklists and mission orders. SAC headquarters authored all the detailed mission plans and expected crews to execute without question. The B-52 crews received very little practice in making scenario-based decisions in a dynamic environment. Their training was disciplined but predictable and scripted.

The first combat flight of B-52s in Southeast Asia, Arc Light 1, demonstrated the difficult transition B-52 pilots would have in moving from a much-scripted mission to execution in a more dynamic scenario. Arc Light 1 saw the destruction of two strategic bombers, eight crewmembers killed, and a poor bombing performance. The Southeast Asia scenario was different from the routine training scenarios over North America and crews struggled to make the correct decisions in unfamiliar environs.

SAC made few quick changes in an attempt to improve crew proficiency. As soon as the radar data was available, crews returned to radar-synchronous bombing. Pilots also began flying in smaller formations, similar to their expected nuclear missions. Eventually, SAC involved Southeast Asia B-52 aircrews in the planning process and gave them small opportunities to make the Arc Light missions look as familiar as was possible. Nevertheless, these were all minor mission adaptations that did little to make the overall mission more familiar, and SAC made no move to alter training or equipment to improve proficiency.

The largest contributing factor to increased crew proficiency was most likely combat experience. The scenarios and required decision points became more familiar to the aircrews with each sortie flown. Proficiency improved over time, but only as aircrews gained experience in theater, and SAC attempted to adapt the mission so it was more familiar to the aircrews.

No evidence exists that SAC implemented long-term policies to improve pilot proficiency. The only significant change to policy or machine, other than the radar data, formation size, and planning cells, was the modification to the B-52 bomb bay. The increased payload, however, did not affect aircrew proficiency. It only allowed the aircraft to carry more bombs.

Arc Light demonstrated that training must afford pilots the opportunity to practice decision-making in order to improve proficiency. Before Vietnam, the bomber crews practiced a much-scripted and centrally controlled mission in which SAC did most of the mission planning for the crews and presented them with pre-determined decisions. When the mission changed, and required pilots to make decisions on their own, they struggled because they were unpracticed.

Aircrew cannot operate on a regular basis as executors only of centralized decision-making, then suddenly expect to be good decision-makers on their own. Intuitively, practice in decision-making improves decision-making. Pilots should receive training in a scenario that most closely resembles what combat will look like. If the situation is recognizable, pilots are more likely to be good decision-makers. In addition, involving pilots in mission planning helps orient the mind to a future scenario and primes cognition. The pilot is already thinking through the goals, cues, causal relations, and expectancies.

For the most part, B-52 missions in Vietnam did not involve a reacting target. Aircrew flew almost exclusively in South Vietnam against static targets. The missions required time-critical decisions from the aircrew, but the Arc Light scenarios were not as dynamic relative to other USAF missions.

Enhancing Combat Crew Proficiency Through a Systems Approach to Training

Following Vietnam, the Air Force attempted to improve both effectiveness and efficiency in training. The Systems Approach to Training, known as Instructional Systems Development, began in the flying squadrons and migrated into the training pipeline of Intercontinental Ballistic Missile operators. This five-step model organized training into a more focused and systematic process.

Implementation of ISD in the initial qualification-training course was the first step to improve effectiveness and efficiency. At Vandenberg Air Force Base, instructors introduced future missileers to their weapon system for the first time. The ISD model created a slightly abbreviated training course as students became more active in their learning and instructors taught based on specific objectives. The reformed course required students to maintain higher levels of situational awareness and practice making more decisions than before. Instructors utilized the most-likely and realistic scenarios that the course authors believed students would experience in their real-life mission.

The Air Force did not implement ISD at the operational missile squadrons until the end of the 1970s. Two negative reports on crew proficiency instigated a change and emphasis in training at the operational combat squadrons. As a result, an ICBM working group developed comprehensive performance objectives, the associated tasks, and the expected standards of performance. In essence, the working group accomplished Step 1 and Step 2 of the five-step ISD model. This allowed operational instructors better to focus their monthly continuation training with ICBM crews. The systems approach created scenarios that were more realistic, and crews practiced making decisions in environments and scenarios familiar to the anticipated scenario of actual nuclear war or missile malfunction. Overall, instructors believed focus on training in the operational squadrons, combined with simulators providing more realistic scenarios, created more proficient ICBM crews.

The ICBM community in the 1970s faced difficult challenges. The mission was constant, twenty-four hours a day, seven days a week and manning levels in the combat squadrons depended on the efficiency of the initial qualification-training course at Vandenberg AFB. To deter the Soviet Union, the nation demanded that missileers focus on their mission to be ready to employ nuclear weapons and simultaneously safeguard the weapon system. At the same time, leadership asked the combat squadrons to do something they had very little time or manning to accomplish—improve operational training and crew proficiency. The combat instructors utilized the systems approach of ISD to enhance training while continuing the deterrence mission.

Differences exist between missileer and aircrew operations. Missileers train and operate within a bounded environment. Their mission is difficult, stressful, and extremely important, but also has a limited number of variables. Almost all the decisions required of a missileer exist in a checklist. In contrast, some combat aircrew deal with a thinking adversary that acts and reacts to aircrew decisions.

Contextual parallels from three different decades of the 20th Century help inform RPA pilot training today. All three studies involved organizations that changed training tactics, machines, or the mission in an effort to improve combat decision-making. The two cases that manifest the greatest improvement in crew proficiency, however, are the two that implemented both short-term and long-term changes in training. The Air Corps and ICBM instructors made significant changes to how they trained combat crews. In contrast, SAC made changes only to the B-52 combat mission and relied on crews to gain experience over time. Historical approaches to combat decision-making inform the present and future approaches.

The Air Corps and ICBM instructors emphasized training among the operational combat squadrons. They made efforts to provide scenarios that were more realistic to pilots and missileers. The Air Corps increased each pilot's monthly training time by ten hours and began systematic usage of flight simulators to provide *practice* in decision-making. Improving the machine and the man-machine interface also helped increase situational awareness and improve combat decision-making. In the late 1970s, event-based training was not adequate, and SAC required missileers to receive monthly continuation training in realistic scenarios. Instructional Systems Development helped focus training into a more effective and realistic format. When combat or emergencies required Air Corps pilots or nuclear missileers to make decisions under stress, their training better prepared them to do so because the goals, cues, causal relations, and expectancies were familiar.

Reaper Pilot Combat Decision-Making

All three case studies inform the development of contemporary RPA pilots. This section analyzes the pieces of the Air Mail Fiasco, Arc Light, and ICBM training that apply to modern combat aviation.

Today, the Air Force should assess both the war machine, the training process, and the training quantity of RPA pilots. Does the MQ-9 cockpit enhance or degrade pilot situational awareness and decision-making? The Reaper cockpit may present too much information in an unwieldy format to pilots, adding unnecessary complexity that impedes scenario recognition (Figure 12). The problem lies not in obtaining sufficient information to make a decision, but rather sorting through large amounts of data found in multiple locations and formats, determining what is relevant, and then making a decision. Presenting the precise information in a simple format increases the likelihood of a pilot more readily recognizing the scenario, based on goals, cues, causal relations, and expectancies. Recognition Primed Decision-making suggests that with scenario recognition comes better decision-making.

Figure 12. MQ-9 Cockpit
Source: af.mil - http://www.af.mil/News/Photos.aspx?igpage=14&igsearch=mq-9%20cockpit

Just as the B-52 pilots complained during the Chrome Dome sorties, MQ-9 pilots can "turn their brains off" for periods during a sortie, or a series of sorties. For example, combat leadership assigns a squadron the task of observing a nefarious compound in order to gather information. While there are many different ways to achieve such an objective, the pilot may simply choose to fly circles around the target for days. The task is simple and requires a small degree of decision-making. To compound the problem, external organizations connect to the sortie because of the unique reach-back capability of the MQ-9. Personnel gathering information on the target use the aircraft sensors manipulated by the crew to collect data. Command and control can also provide input to the pilot. These external agencies, experts, and commanders can reach into the pilot's cockpit and sometimes directly or indirectly make decisions for the aircrew. Pilots may grow accustomed to other personnel making decisions on behalf of the aircrew.

When the mission changes, and requires pilots to make the decisions on their own, they struggle because they are unpracticed. MQ-9 crews fly scripted intelligence-gathering missions and then suddenly receive orders to execute dynamic strike missions. If Reaper pilots spend 95% of their time flying routine reconnaissance missions and then receive orders to execute an extremely difficult strike with strategic consequences, without any recent practice or training, the likelihood of not recognizing the scenario and making incorrect decisions is high. If, on the other hand, MQ-9 pilots spend the same percentage of combat time flying the reconnaissance missions, but also practice difficult and dynamic strikes regularly in training, they are more likely to recognize the scenario and make correct decisions when required.

RPA pilots experience little monthly training. Pilots receive quality instruction at the initial qualification course. Once they report to a combat squadron and start contributing to the war effort, however, combat exigencies demand nearly all of their aviation time in combat. Because they rarely receive dedicated training time, MQ-9 pilots find creative ways to complete required training *events*. Reaper pilots are essentially "self-trained" after becoming combat qualified. Nevertheless, training to *scenarios*, increasing the likelihood of combat scenario recognition, providing opportunities for decision-making *practice*, and providing constructive feedback on selected courses of action requires dedicated time and instruction.

Proper use of simulation will enhance Reaper pilot proficiency. The current system does use simulators to train MQ-9 pilots. The simulators are excellent tools for teaching and maintaining currency in checklist procedures, systems familiarization, and emergency procedures. If instructors wish to utilize the simulators for scenario training, however, the system lacks robust capability. The student may struggle to identify familiar cues and a familiar environment on which to base future decision-making. To be useful in improving combat proficiency, MQ-9 simulators must be capable of scenario replication to the extent that a pilot easily recognizes the environment and can therefore project a correct course of action forward to a logical, positive conclusion.

Today, RPA combat squadrons each accomplish training in the manner they deem best, with the limited resources of time and manning. Because manning levels are low and the combat mission requires all qualified personnel to devote their entire effort to the wartime objective, very little dedicated, much less focused, training occurs. Each squadron authors its own training scenarios and figures out a training plan. Most squadrons are unable to accomplish much dedicated monthly training.[2] What they do accomplish is ad-hoc and focuses on *events* rather than *scenarios*.

With increased manning and dedicated time, the Air Force could standardize and focus continuation training of RPA pilots at combat squadrons. The RPA community may see increased effectiveness in training if they approach training more systematically. The first three steps of the ISD model are: analyze system requirements, define education and training requirements, and identify objectives and tests. Accomplishing these steps, or a similar systematic approach, would focus training and develop appropriate scenarios for both live-fly training and simulator training.

The Air Force can improve RPA pilot combat proficiency with two changes. First, pilots need more training time. Pilots cannot expect to be proficient in combat if they cannot practice decision-making in a consequence-free environment.

Second, MQ-9 pilots need to receive more scenario-based training. The small amount of training Reaper pilots experience at operational squadrons is event-based and executed ad-hoc. The RPD model highlights the importance of scenario recognition in combat decision-making. The only way to recognize scenarios is to practice them. Training needs to focus on scenarios that pilots do not see on a daily basis in order to prepare them for the less common, but highly important scenarios.

Leaders and policy-makers should not be lulled into thinking that more automated war machines require less training. The MQ-9 is a cumbersome aircraft to fly due to the poorly designed human-machine interface. Even if engineers made pilot functions easier within the system, however, pilots need significant amounts of training in order to be successful in the combat environment. Current automation does not eliminate the need to make stressful, dynamic, quick decisions that have significant consequences for the

[2] Unattributed interviews with RPA pilots and the author's own experience.

aircrew, personnel on the ground, the battle's outcome, or international relations. Decision-making is only taught through dedicated scenario-based training led by an experienced instructor.

A Systems Approach to Training is one potential format to help institute scenario-based training. Because the RPA community grew so quickly and has dedicated so much time to the combat effort, no specific time, format, or routine for training exists. Squadrons do the best they can with the available manning and time. Applying a Systems Approach to Training would allow RPA instructors to focus training in the most relevant areas and help refine training objectives.

Practice in real war is dangerous. It is dangerous for personnel on the battlefield, dangerous for non-combatants, and potentially dangerous for the nation employing such a strategy. Combat proficiency, obtained before belligerents fire the first shots, lessens the effects of fog and friction and reduces the probability of mission failure and unnecessary loss of life. MQ-9 pilots must gain proficiency through a structured combination of live and virtual training, executed in peace-time.

Unanswered Questions

The research for this work generated many questions beyond the scope of this paper. Three general areas require further study.

First, as we look to the future of combat aviation, should Remotely Piloted Aviation pilot training look different from traditional pilot training? The Air Force created a dedicated RPA pilot training, distinct from traditional pilot training. Because the Air Force shortened RPA pilot training more than traditional pilot training and does not include actual flight, but relies solely on simulation, does it reduce the quality of training? What aviation skills does an RPA pilot require and does URT teach those skills?

Second, the Air Force should assess the quality and quantity of simulators in RPA training. Even though MQ-9s are distinct from other aircraft in the format and fidelity of visual feedback of the aircraft environment, should the Reaper simulator match the actual aircraft sensor fidelity? Does the change in simulated graphics of the targeting pod sensor negatively affect crew performance? When the aircraft receives software updates, does training in a simulator with outdated software have a negative affect on crew decision-making? Does the Air Force need more simulators for crew training?

The last area requiring further research involves the human-machine interface. The MQ-9 cockpit remains a system designed by engineers for engineers, not aviators. Does the cockpit design and levels of human-machine interaction decrease pilot proficiency? Would a cockpit design similar to traditional cockpits increase pilot situational awareness, decision-making, and execution abilities? As the Air Force adds new sensors and weapons to the aircraft, how should engineers integrate them into the human-machine interface?

The Future of RPAs

The Air Force and combatant commanders demand a lot from the multi-role RPA squadrons. Before the Senate Armed Services Committee, General Carlisle, Commander of Air Combat Command, explained the breadth of missions given to MQ-9 pilots. "[The pilot] could do close air support, he could do solely [intelligence, surveillance, and reconnaissance], he could do strike, he could do personnel recovery, he can do interdiction, he can do interdiction of targets in the deep fight. The missions that our RPAs fly, it's a theater-level asset given to the joint force commander for his allocation to meet the theater-level missions that he's trying to do."[3] MQ-9 pilots must be proficient in their profession.

Future warfare will include remotely piloted aircraft. Today, as the Air Force programs resources and sets policy, is the organization postured to produce the combat decision-makers and battlefield aviators required in future combat? As we look at the art of the possible, have we applied the right amount of creativity, leadership, resources, and courage to prepare for tomorrow's fight?

Focused scenario-based training and dedicated training time will create better combat decision-makers. The Air Force has implemented numerous short-term fixes to enhance RPA pilot training. It is now time to implement an effective long-term fix by

[3] Phillip Swarts, "Air Force, Army need separate drones, generals tell Congress," *Air Force Times,* 20 March 2016, http://www.airforcetimes.com/story/military/capitol-hill/2016/03/20/air-force-army-need-separate-drones-generals-tell-congress/81942010/.

providing the community time to train and the manning to execute realistic scenario-based training.

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