PERCEPTIONS OF PILOTS AND NAVIGATORS CONCERNING THE FUTURE PROSPECTS OF THE UNITED STATES AIR FORCE AIRBORNE WARNING AND CONTROL E-3 NAVIGATOR

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C O P Y R I G H T

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NOMENCLATURE

AWACS	Airborne Warning and Control System
GINS	GPS Integrated Navigation System
GPS	Global Positioning System
INS	Inertial Navigation System

CHAPTER I

INTRODUCTION

The aviation navigator has been around since the early days of aviation. Countless lives have been saved due to the skills of dedicated navigators. In the early days of aviation the pilot usually did his or her own navigation until aircraft became too complex and flew too high for the pilot to do both jobs. Subsequently, a dedicated navigator position was established to ensure pilots did not become disoriented and task saturated by doing both duties over long distances and large bodies of water. During World War II the position was developed and utilized extensively to get military aircraft on time over the right target. As aircraft became even faster and more complex, the navigator was essential both to navigate and deploy weapons (Bowditch, 1984).

Statement of Problem

As technology has replaced some of the responsibilities of the navigator, and even replaced the navigator entirely in most civilian aircraft and some military aircraft, many people questioned the importance of the navigator position on the aircraft altogether (Kotter, 1976). United States Air Force leaders have intentionally or unintentionally begun to under-utilize the position, depending more on the technology such as the Global Positioning System (GPS) to back up the pilots. This technology dependence has led some

senior military leaders to remove or consider removal of the navigator position from many Air Force weapon systems. Therein lies the problem. Specifically, should the navigator remain or be removed from the E-3 due to the increased GPS technology added to the E-3 AWACS?

To answer this question it was essential to provide general information concerning the E-3 and other weapon systems that may face the same dilemma. However, the focus was specifically on the E-3 problem and the mention of those other weapon systems was only used to strengthen the discussion on the problem area and indicate that technology updates to other Air Force aircraft have generated the same concerns. To know these concerns it was essential to first describe those aircraft and their missions.

The Airborne Warning and Control (AWAC) weapon system, more commonly known as the E-3, is itself predicted to be at the end of a long line of aircraft replaced due to increased technology. The E-3 is an airborne military radar platform, which allows an over-the-horizon look at other airborne traffic to provide early warning, surveillance, and air battle management to friendly forces.

Other aircraft slated for future termination will eventually include the RC-135 (used to monitor signals and gather intelligence), U-2 photo reconnaissance aircraft, EC-130 airborne command and control center (ABCCC) (used as a radio relay and airborne battlefield manager), and the E-8 Joint Strategic Tactical Air Reconnaissance System (JSTARS), which tracks ground vehicles and equipment, relays the target to airborne fighter aircraft for targeting (Fulghum, 1997). All of the above aircraft represent most of the U.S. Air Force battle management and command and control capability platforms slated for retirement (Fulghum, 1997). Additionally, as space systems become more and

more dependable many flying slots in the U.S. military will start to disappear (Fulghum, 1997). It is estimated that by the year 2020-30 most of the crews conducting intelligence, surveillance, and reconnaissance (ISR) missions will be grounded and replaced by the long-endurance unmanned aerial vehicles (UAV) and satellites (Fulghum, 1997). But, according to Fulghum, AWACS' mission will be the last to transition to space because of the frequency of target updates required and satellite orbital mechanics. It is an economic reality that the United States must find less expensive methods to fund a standing military and more specifically expensive aircraft weapons.

Purpose of the Study

The purpose of this study is to determine whether or not the usefulness of the military navigator has passed in the E-3, due to the improvements made in the navigational systems. The study will provide a brief history of the United States Air Force AWACS E-3 navigator. Second, the study will provide some perception, morale, and retention problems generated by Air Force human resource management initiatives toward the navigator. And finally, determine if pilots and navigators within the AWACS weapon system perceive a need for the navigator after the GPS modification is complete.

Scope and Limitations

The scope of this study will be limited to the perceptions of the E-3 pilots and navigators assigned to the 552nd Air Control Wing at the time of this study. The history of the E-3 navigator and perceptions of Air Force human resource management practices toward the navigator are based on information gathered by other Air Force studies

conducted mostly by Air Force navigators and pilots. This study will not deal in depth with Air Force problems of morale and retention. Also, the study will only survey Air Force E-3 pilots and navigators assigned to the 552nd ACW at the time of the study and will not survey previous E-3 pilots and navigators. This is primarily due to time and financial limitations of the study. Finally, the study focused on pilots and navigators in the grades from second lieutenant to lieutenant colonel to attempt capture of those perceptions and attitudes of those who primarily fly the E-3 at the operational level.

Assumptions

The information gathered from the surveys, previous studies, and interviews were assumed to be the writers and respondents honest assessments and perceptions of the situation as they perceive it prior to and during the period of this study.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The review of the literature provides a comprehensive background into the decision to include the navigator as a fourth crew member in the early development of the AWAC E-3 aircraft. Secondly, the review will address the subsequent under-utilization of the position as a result of aviation instrument modifications and other U.S. Air Force personnel initiatives.

The review of literature has been divided into five key areas:

1. History of the E-3 navigator;
2. Past and present management of the U.S. Air Force navigator force;
3. Perceptions, morale, and retention problems generated by the U.S. Air Force human resource management practices toward the navigator;
4. Whether pilots and navigators now serving in the weapon system perceive a need for the navigator.

A History of the AWACS E-3 Navigator

The Decision for the Fourth Seat

The decision to include a navigator in the E-3 was almost as great a controversy as the airline's decision to eliminate the flight engineer from the cockpit of air carriers. Specifically, the issue of whether or not to use a flight engineer or a navigator on an airliner was primarily an economic and safety concern (Komons, 1987). Due to the critical necessity of accurate navigation over water, the navigator was employed in the 1950s and 1960s on transoceanic flights in the civilian aviation community (Komons, 1987). The beginning of the end for the airborne navigator came in February 1962, when the Federal Aviation Agency authorized Trans World Airlines (TWA) to employ the new Doppler navigation system (Bowditch, 1984) in lieu of celestial navigation over the North Atlantic (Komons, 1987). Conversely, according to Boeing officials, the decision to include the navigator on the E-3 was due to the nature of the E-3 mission and the need to have celestial navigation as a backup to other navigation systems. Specifically, precise navigation was essential to mission success, and the fact that the E-3 was a national asset drove the decision to include the navigator as an extra set of eyes in the cockpit along with the flight engineer. The United States could not afford to lose the E-3 to the careless navigation mistake of a task-saturated pilot under austere flying conditions and under extreme stress. Due to the critical nature of this E-3 mission, the selection of crewmembers for this national asset mission was very meticulous.

A Tough Selection Process

The initial selection process for the E-3 was very carefully planned and executed in the early to mid-1970s. Only experienced pilots, navigators, and flight engineers were allowed to join the elite group of seasoned Air Force veteran aviators. As crews gained more experience with the weapon system, newly trained pilots and navigators were allowed to join the ranks of the elite if they performed well enough in undergraduate pilot and navigator training. Newly trained navigators were required to graduate in the top 20% of their class to be considered for navigator duty in the E-3. The reasoning behind the tough selection criteria was due to the sensitive areas the E-3 would fly and the complex systems onboard, which justified requiring the services of those graduating in the top of their class.

High Value Asset Justifies Need for the Navigator

The need for a high value graduate was justified by the high value of the aircraft and the mission. In 1982, the value of an E-3 in 1977 money was $135 million according to AWACS historical documents. The nature of this national asset's mission required the navigator to operate a dual Inertial Navigation System (INS) (Bowditch, 1984), Doppler, and Omega according to Air Force navigator instructors stationed at the 552 AWAC Wing. These systems were state-of-the-art in the late 1960s and early 1970s but unfortunately had a tendency to drift as the mission progressed. Specifically, "to drift" means the aircraft position estimate of the INS equipment would degrade or become less and less accurate as the mission continued. This inaccuracy was mainly caused by fewer

position updates manually placed into the equipment by the navigator due to the lack of ground references. The Omega navigation system (Bowditch, 1984), which used Low Frequency (LF) signals received from 12 Omega ground stations positioned around the world, was fairly accurate dependent upon where the receiver aircraft was in relation to the stations, and other variables such as atmospheric conditions, solar storms, and magnetic disturbances. Many times the Omega computer would insidiously induce errors into the INSs and drive the E-3 position further off course. On one occasion, a new second lieutenant AWACS navigator on his first unsupervised crossing of the Atlantic Ocean, noted the Omega computer had driven his aircraft position off course by more than 13 nautical miles. Essentially, it was only after six celestial observations on stars and planets that he was convinced his Omega computer flight instrument had malfunctioned and caused the course deviation. It was due to known or predicted navigation instrument problems of this nature that the Defense Department decided to hire the human navigation element to counter the possibility of an E-3 running out of fuel or straying into enemy territory unknowingly and possibly being shot down.

Another very real danger that has the respect of every aviator and sailor is fuel and energy consumption and conservation. In Dava Sobel's classic best selling book *Longitude* he pointed out that due to the lack of navigation skills many early sailors perished on the high seas from malnutrition and dehydration because they could not estimate their longitude on the ocean (Sowell, 1997). Since mariners could not store an infinite amount of food and water on their ship nor determine their progress across the surface, they exhausted their supply long before reaching land. In contrast, the aircraft, by its design, has somewhat overcome the problem of relying solely on the wind to propel its movement

above the earth's surface due to its speed and power. However, it too cannot carry infinite supplies or fuel. Therefore, the crew must rely on their navigation skills and instruments to avoid exhausting those fuel, oil, and oxygen supplies. Unfortunately, even today aviators have become disoriented to the point of depleting fuel supplies and crashing or ditching. Basically, the United States could not afford to lose the E-3, a very limited asset, to gross errors in piloting, navigation, nor enemy aggression, and therefore hired a full complement of aviation expertise to include the navigator.

Mission Dictates the Need for the E-3 Navigator

The E-3 was designed from a Boeing 707 airframe and planned for only a 20-year life span, according to Boeing and Air Force senior AWAC leadership. Originally, the intent was to develop a system for early warning should the U.S.S.R. attack. The primary mission was to detect inbound enemy bombers and fighters, and vector friendly fighters to intercept and destroy the aggressors. The navigation system accuracy on the E-3 is absolutely critical to the accuracy of the mission radar. Therefore, the navigator's mission was to maintain the accuracy of these systems that had a history of drifting, as mentioned previously (E-3 Navigator Training, 1982). Additionally, if the mission placed the E-3 near a hostile border, it was and still is essential that the navigation of the aircraft be precise to keep the E-3 out of harm's way.

The E-3 mission has evolved over the years from primarily a defensive platform to be both defensive and offensive (552 Air Control Wing (ACW) Mission Statement, 1997). During the Gulf War (Desert Storm) the offensive force multiplier aspect of the mission was realized as the E-3 assisted in the shoot down of 23 Iraqi MIG fighter aircraft (552

AWACS Desert Storm Archives, 1991). These assistance vectors made by weapons directors (WD) aboard the E-3 were force protection measures taken while marshaling large fighter and bomber strike packages to and from their assigned target areas. These vectors would not have been possible without pinpoint navigation accuracy provided by the navigator.

Past and Present Management of the U.S. Air Force Navigator Force

The E-3 Navigator

The E-3 navigator position was in a state of fluctuation as of the date of this study. The old navigation system described above was slowly being replaced by a dual Global Positioning System (GPS). The navigator was still an integral part of the flight crew and was considered the expert in GPS navigation on the E-3. The new system reduced the workload of the navigator and the pilots considerably if the system hardware and software did not fail. On several occasions, after GPS modifications were complete on the E-3, both the software and hardware failed. This left the E-3 pilots to rely totally on the skills of the navigator to return the systems to a normal configuration or navigate back to home base by celestial navigation methods if outside of the range of radio navigation aids. (A radio navigation aid or beacon used most by the military and civilian aviation community is the Tactical Air Navigation (TACAN) system, or its more advanced version, the Variable Omni Range TACAN or VORTAC). These systems were fixed ground based electronic units that emitted 360 beams of energy, referred to as degrees or radials. These 360

degrees represented a compass, which also had 360 degrees depicted on its face or front. If an aircraft carried distance measuring equipment called DME, (which determined electronically how far an aircraft was from the emitter or ground station) and a receiver unit on the aircraft, an aircrew could determine where they were in relation to this ground device (USAF Undergraduate Navigators Training manuals, 1982).

Basically, this new dual GPS modification has eliminated the necessity of TACAN, Doppler, and Omega dependence for continued navigation use. Subsequently, ground navigation stations have started to shut down. Omega has officially shut down its operation throughout the world as of October 1, 1997; if the plan is adhered to the TACAN and VOR ground stations will stop operations just after the turn of the century. Therefore, the E-3 will eventually be totally reliant on the skills of a navigator, (if retained in the service of the E-3) dual GPS, and dual ring-laser gyros. Furthermore, to further reduce the tools available to the navigator, celestial navigation was discontinued as a curriculum subject in Air Force Navigation schools on October 1, 1999 (interview with instructor navigator personnel at Randolf AFB, Texas, April 12, 1999). As a result of this projection, Major Mark Morton, Chief of 552nd ACW Operations Group Requirements, on March 1, 1999, stated AWACS no longer required navigators to practice celestial navigation due to the sextant parts contract termination and the wing's subsequent inability to maintain sextants for operational flying. According to an interview with Colonel M. Tarpley, Inspector General for the 552nd ACW, December, 1997, the E-3 modification of GPS came at the right time because the reduction in the military budget had left the Doppler and sextant parts inventory almost exhausted. He further predicted during the interview that those two systems (doppler and sextant) would eventually be

removed from the E-3 rather than relying on the United States government to prolong the system's life span by re-negotiating a budget and contract to locally manufacture new parts for these systems. As previously mentioned, this would eventually make the E-3 system totally reliant on the capabilities of GPS technology. Tarpley warned, however, that total reliance on the GPS system would place the E-3 weapon system in jeopardy because work was probably already in progress by potential adversaries to jam the GPS signal and confuse GPS users in battle.

It is very likely that the navigator will eventually be removed from the E-3 for economic reasons but especially when specialized training for the pilots catches up to the modifications of the aircraft. Essentially, the system that was meant for a 20-year life span is now projected well into the 21st century so economic considerations must enter the navigator argument to help fund future E-3 improvements like the glass cockpit. E-3 navigators may or may not be a part of that E-3 future, dependent on further navigation and avionics systems upgrades (glass cockpit) with increased dependability, economics, and changes in the mission. Specifically, the navigator may not be needed if training and system redundancy make their retention less cost effective.

Removal of the Navigator in the KC-135

The KC-135 air refueling tanker has undergone many changes in the past several years. This was another weapon system that was also forecast to continue service well into the 21st century. To increase the KC-135's life span the aircraft was re-engined, re-painted, and re-skinned in preparation for continued service. In April 1994, General Ronald R. Fogleman, who was then commander of the Air Mobility Command (AMC)

ordered the removal of the navigator from the KC-135 because of a projected navigator shortage throughout the Air Force. Rather than keep Air Force aircraft on the ground due to a shortage of navigators, General Fogleman reasoned that the Air Force could redistribute the remaining navigators to more needed weapon systems and the remaining KC-135 pilot force would be re-trained to operate without the aid of a human navigator. However, according to a flight test summary written by the squadron commander of the 33rd Flight Test Squadron, the initial testing of the new crew composition revealed that the pilots became overwhelmed or task saturated with flying the aircraft, staying on course, and deviating around thunderstorms (Poindexter, 1994). The squadron commander went on to say that "this test was completed under controlled conditions--under wartime conditions this saturation could jeopardize safety and the mission" (AMC soon realized the removal was premature and returned the navigator to the cockpit until an elaborate $5.3 million avionics relocation package (Pacer Crag) was installed). This project started in early 1998 and is scheduled to be completed in 2001 (Poindexter, 1994). These modifications will probably assure an end to the continued service of the navigator on the KC-135.

The KC-10 Decision

In the early 1980s the KC-10 air refueling tanker came on the scene to be the replacement for the aging KC-135 fleet. Much to the chagrin of the U.S. Air Force Strategic Air Command (SAC) navigator community, the navigator position was not included in the initial crew composition. According to Colonel Mark Tarpley, who was stationed at the Pentagon at the time of the KC-10 decision, it came down to one senior

ranking individual in the research and development (R&D) branch who simply red-lined through the navigator position on the initial crew complement recommendation. This aircraft was one of the first with a triple INS and a fully automated preflight system for the flight engineer (KC-10 air crew interview, June, 1997). Also, for the first time in SAC history the flight engineer was officially utilized to operate the navigation systems on the KC-10 (KC-10 air crew interview, 1996). The same growing pains were realized with the KC-10 crews as with the aforementioned KC-135 transition without the navigator. Complaints abounded that the KC-10 crews were task saturated and on many occasions drove off course and led receiver aircraft into thunderstorms or out of Air Traffic Control (ATC) laterally protected airspace. The KC-10 crews also had the dubious distinction of being the Air Force crews who have had the most ATC violations on record (interviews with KC-10 air crew members, 1982-1997).

Role of the Airlift Navigator

Like the KC-135, KC-10, and E-3 weapon systems, the airlift systems had been evolving too. The C-141 Starlifter, C-5 Galaxy, and the C-130 Hercules were the mainstays of the airlift community. The Starlifter, Galaxy, and Hercules aircraft are the Air Force's main cargo and troop transport carriers. They conducted routine cargo delivery missions or air-drop of both cargo and troops to areas too hostile for landing. Initially, the navigator played a key role in those three systems, but with the modifications of the navigation systems today the navigator is used only for the most demanding of missions in the Starlifter and Galaxy, such as the low-level airdrop sorties. The C-130 Hercules still employs the navigator, but the new C-130J has removed the navigator from its service.

There have been a few reported cases of airlifters without the aid of a navigator for over water missions finding themselves off course due to drifting INS equipment and taking drastic measures to find their way back to course (Moeller, 1976). There was an unofficial report of a C-141 crew that had to resort to following contrails of an airliner over the ocean after broadcasting their minimum navigation capability on GUARD radio. Pilots and navigators alike have always feared being disoriented and depleting onboard fuel supplies. Clearly, the unique military mission requires a conservative approach to maintaining redundant systems on the aircraft. (Redundancy may have a negative connotation to some, but in this context it relates to having enough backup systems to facilitate mission completion--lives and fates of countries may hang in the balance).

The Role of Bomber, Reconnaissance, Fighter, Electronic Warfare, and Special Operations Navigators

The Air Force has continued the employment of the navigator in the most demanding of missions. Those missions are the missions of the bomber navigator (B-52 and B-1), the fighter or weapons system officer (WSO) (F-15E), electronic warfare officer or EWO (B-1, B-52, RC-135, C-130E), and special operations navigators and fire control officers (FSO) (AC-130 Gunship). These critical and unique missions require the utmost in precision and flexibility and cannot be trusted, at this time, to a machine or computer. An unknown author once said you can't program courage into a black box. At present, there still is not an aircraft system in the military that does not require electricity or batteries to operate. During combat, if all systems were damaged, some missions could still be completed if the redundancy of a navigator/WSO/EWO/FSO could be relied upon to

manually deliver bombs on target, jam the emitter, or just get the crew home to fight another day (Webster, 1970).

The Ideal Staff Officer

In a telephone interview with the Chief of Rated Officer Aircrew Management at Air Material Command (AMC) (October, 1997), who was himself a successful lieutenant colonel navigator, the removal of the navigators in the aforementioned weapon systems and the future of the Air Force navigator in general was discussed. (Prior to October 1999 a rated officer in the Air Force was a pilot or navigator, similar to the ratings civilian pilots are required to have to compete for and retain commercial airline jobs. On October 1, 1999, the U.S. Air Force Chief of Staff General Michael Ryan authorized officers holding qualification as Air Battle Managers, or their more commonly known designation as 13B, to be classified as rated officers.) The Chief of Aircrew Management at AMC stated that even though the navigators were being removed from some of the less demanding missions in the Air Force, they were still needed on the staff. Only a rated officer (pilot or navigator) could truly understand the day-to-day needs of an operational flying unit and provide that critical support for the unit at the headquarters level. Basically, the positions on the aircraft may have diminished, but the staff will require the expertise of the navigator and pilot well into the next century (Watkins, 1995).

Perception, Morale, and Retention Problems of the Navigator

Although navigator retention in the Air Force was higher than pilot retention at the time of this study, it was still considerably lower than it should have been, according to

AMC staff officers. The navigator retention rate in AMC was approximately 70% according to the Chief of Rated Aircrew Management at AMC (October, 1997), and the pilot retention rate had almost always been considerably lower. It was and still is understandable that a pilot would want the opportunity for a lucrative position of a captain in the left seat of an airliner, eventually earning a six-figure salary. Many have chosen that route for stability alone, rather than dealing with long family separations and unpredictable schedules associated with military life. The irony of the stability issue was that during the dangerous Cold War years many military members were staying in the Air Force for the stability and job security. Later, due to the unpredictability of austere military budgets in the 1990s, what little stability there was had gone. This became a key contributing factor for those who had decided to leave the service (AMC interview, October, 1997). In 1996 General Ronald Fogelman, the Air Force Chief of Staff, tried to counter this mass exodus of pilots by limiting days on temporary duty (TDY) to 120 days per year and increasing the maximum bonus to $25,000 a year for some pilots. This bonus, which went into effect in early 1989, was partly attributed to navigator dissatisfaction (Urban, 1989). The navigators, on the other hand, had similar retention problems in the 1990s, but no bonus was offered to them. Also, navigators who stayed in the Air Force had a very limited opportunity for upward mobility. Essentially, most navigators can hope for promotion to only major or lieutenant colonel, and few will see the rank of full colonel or general. This is a glass ceiling similar to that experienced by women and minorities in previous years in the military. However, some are of the opinion that the discriminating policy may only be a move to reduce the number of navigators, as technology improves, through attrition rather than massive reductions-in-force that disrupt military members and their families.

You're Good Enough to Fly but Not Command

Many Air Force navigators have experienced this glass ceiling when told there are very few command opportunities (Care, 1972). However, the AWACS navigator has historically been the exception in recent years (1990 to 1999) and enjoyed an unusually high degree of success in obtaining director of operations (DO) and command billets.(AWACS Archives, 1999). This was partly due to the increased exodus of the pilot force as a result of an excessive TDY rate within the AWACS community (Interview with Major Bill Tully, Air Combat Command (ACC) E-3 Contingency Operations and Program Manager, August, 1999). However, very few navigators have stayed the course to compete for the narrow opportunities to direct or command an AWACS squadron. As mission crewmembers were also rated on October 1, 1999, it became even more difficult for a navigator to command an AWACS squadron due to aforementioned historical legislation to mandate the acceptance of non-rated officers (those who hold 13B career field designations, and who operate equipment and direct the command and control mission of the E-3) into the competition for flying squadron commander billets. Previously, only pilots could command a flying squadron, but restrictions were lifted to allow any rated officer the opportunity because navigators were trained aviators too, and pilots were leaving military service (Care, 1972). (See Title 10 discussion later in this report) Indeed, it was even more difficult to motivate young pilots and navigators to remain in the service of their country when officers not trained as aviators were allowed to command flying squadrons.

These previous non-rated officers (all Mission Crew Commanders [MCC]) were at a considerable disadvantage in flying squadrons until they learned enough to make sound decisions concerning the flying aspects of aircraft they managed and the pilots and navigators they commanded. Those selected thus far were hand-picked from a pool of superior and intelligent officers, but concurrently, the talent from the rated community was slowly diminishing due to the very real perception that upward mobility was becoming stifled (Interview with Major Tully, August, 1999).

Second Class Citizen

The navigator was always thought of as a second class citizen in jest (Care, 1972). Many navigators, like their previous non-rated peers, had to settle for the less desirable positions within the Air Force since the beginning (Care, 1972). The Air Force allowed the flying squadron command leadership development of other officers only after the pilot shortage had reached a chronic stage due to the allure of the airline industry (Gambrell, 1973). Fortunately, the paradigm shift to allow other than pilot leadership to command squadrons in the Air Force reaped the benefits of discovering talent that would have otherwise been lost in a not too distant past. Like that of most bureaucracies, the learning process for an institution such as the Air Force has been slow. If the Air Force or any other military institution cannot learn to motivate and identify talent more expeditiously and fairly, those organizations will suffer the consequences and possibly jeopardize the nation's defense with only second class talent.

No Bonus for the Navigator

Many government problems are answered with money. The chronic pilot shortage has been no exception. For many years now the Air Force has dealt with the pilot shortage by offering large sums of money to young pilots to sign for additional years, only to see them walk out the gate with their experience for lucrative careers in the airline business when their commitment is finished (Denney, 1990). Navigators, on the other hand, in general have enjoyed higher retention numbers Air Force wide, due to the navigator career field not being marketable, thus no bonus has been required (Denney, 1990). However, there have been shortages in some weapon systems that fosters a perception among some navigators that discrimination has occurred with the bonus. (Poindexter, 1994) This discrimination had left the perception among the navigator community that the Air Force was interested only in getting prime work life years from the navigator (Poindexter, 1994). Basically, when the navigators meet the promotion board to Major, which is considered the first career milestone, they find that the organization seems to be interested only in getting additional flying service from them, while conversely their peer pilots receive lucrative bonuses to continue flying, move to key staff positions, or they take the option to leave the Air Force entirely for airline jobs (survey results, see Findings, Chapter IV). This type of personnel management breeds discontent among the aviators and eventually depletes the military of its experience base.

Promotions

Traditionally, the pilots have always been promoted at a greater rate than navigators (Denney, 1990). To illustrate this point for only one year during the Vietnam conflict (1970), the average promotion percentages to lieutenant colonel reflected the pilot promotion rate at 53%, the navigator rate at 45%, and the non-rated rate at 42%; to colonel the pilots were promoted at a rate of 15%, non-rated officers were promoted at a rate of 10%, and last was the navigators at 9% (Semple, Heapy, Andross, and Mac Argel, 1974). By comparison, twenty years later in 1990 navigators again had the lowest promotion rate to lieutenant colonel among all Air Force line officers on that promotion board (Urban, 1989). Unfortunately, to curb the shortage of navigators in the cockpits, 1999 Air Force policy dictated that the navigator was required to serve in the cockpit for 144 months uninterrupted (12 years) before being released for other duty. This hindered mobility within the system to move to more lucrative staff positions to compete for promotion to major and lieutenant colonel. If some were given special permission to leave for a short career broadening tour elsewhere, they were directed to return immediately afterward to finish their 144 months before their flying commitment was considered complete (1999 Air Force Policy). This led to many officers being pulled from high-level staff positions prematurely and returned to the cockpits just prior to promotion boards (Interview with Major Tully, August, 1999). This untimely arrival of a new officer in a unit would, in most cases, subsequently get that same officer passed over for promotion (Interview with a passed-over AWACS major, October, 1997) This situation was primarily due to his unfortunate status of being new, unproven in the air, and allowed to

serve only in a squadron position as a line navigator. With this system, promotions were lost and careers were ruined due to the mismanagement of the Air Force rated officer management system.

Is There Still a Need for the E-3 Navigator?

There is still a perceived need for the E-3 navigator based on empirical knowledge. The installation of the GPS modification on the E-3 known as GPS Inertial Navigation System (GINS) was gradually introduced into the force as the initial cadre of instructors were being trained at Boeing (Interview with Major Greg Hart, Chief of Flight Crew GINS Training for the 552nd ACW Operations Group, October 1997). Unfortunately, there was time to give the pilots only a superficial amount of training, and the remaining time was concentrated on the navigator (Interview with Hart, 1997). Therefore, the navigator was the key to training continuity in the E-3 and was required to be thoroughly familiar with the system to ensure mission success. Major Hart indicated that pilots had very little interest in the GINS initially; therefore, according to Hart solo pilot and flight engineer operation of the E-3 without the navigator was inconceivable until training for the pilots improved, to include modification of simulators, which was years away from completion.

Just How Accurate is the GINS

The GINS had hardware and software problems that needed to be resolved before the system was considered fully operational (Interview with Captain Pearson, Boeing, Seattle E-3 Test Navigator for the Air Force, October, 1997). On several occasions, the

aircraft was established in a mission orbit and would break out of the pattern without warning, primarily due to software anomalies (Interview with Captain Pearson, October, 1997). Navigators needed to be constantly vigilant to inadvertent orbit deviations and be prepared to quickly return the E-3 to the operational orbit before conflict with other traffic occurred (Interview with Captain Pearson, October, 1997). Additionally, another anomaly that required the utmost in crew alertness was the problem with sudden excessive bank angles and removal of stabilization guidance to pilot instruments (Interview with Captain Pearson, October, 1997). This problem resulted in unplanned course deviation and in some cases an altitude loss (Interview with Captain Pearson, October 1997).

If the GINS loses total electrical power it must rely on battery power to navigate to a known point (E-3 technical orders). Once battery power is depleted, no navigation instruments remained except the standby magnetic compass. The navigator was essential to this scenario if the GINS failure occurred over water. Until March 1, 1999, celestial navigation was the only capability remaining after a total electrical failure (Major Mark Morton, March, 1999). Unfortunately, as previously mentioned, the parts supply for the sextant was exhausted and there was no new money allocated in the budget to manufacture or buy sextant parts (Briefing by Major Mark Morton, March 1999). As mentioned previously, the only method now remaining for E-3 navigation without the sextant is the magnetic standby compass and the watch (E-3 Technical Orders). The commercial airliner would rarely have a need to resort to this level of navigation due to state-of-the-art redundant avionics and navigation systems, but a military aircrew may likely encounter this problem during combat due to older, less redundant and capable systems. The choices ahead for the Air Force are to retain the use of the navigator,

increase pilot training, or acquire an avionics system redundancy to replace the redundancy provided by the navigator. If one crew and aircraft are saved due to the vigilance of a navigator, better trained GINS pilots, or a state-of-the-art avionics system, the investment will more than pay for itself when considering the cost of replacement of an entire aircraft and crew.

What Do the E-3 Pilots and Navigators Think?

Experience has revealed that pilots want the navigators to stay in the cockpit, while navigators, in contrast, saw their jobs as slowly becoming less important (study survey results, see Findings, Chapter IV). Pilots were apprehensive about doing the mission without the navigator due to the minimum amount of training they had received. However, the pilots believed this would change if the training became more formalized and simulators were modified to challenge the crews more heavily and realistically in a more controlled environment (study survey results, Chapter IV). Planned simulator modifications after GINS introduction originally included the navigator station, which was historically never a large priority, but could be reversed if economics dictate removal of the navigator (Interview with Major Brad Crawford, Chief of 552nd ACW Operations Group Flight Crew Training, December 1997). The navigator future in the E-3 weapon system may depend on the critical nature of the mission, but most are prepared to move to more challenging duties if told they are no longer needed in the E-3 (survey results, see Findings, Chapter IV).

Safety

A prime consideration of any aircrew member should be safety. The military and especially the E-3 AWACS is no exception. Safety has been ingrained into every aspect of Air Force aviation. Safety is a perpetual training process and should always be considered in any operation short of war. Even in war there is a concern for safety to avoid fratricide or self-attrition. Safety was the prime consideration of some advocates that felt the navigator should stay on the E-3 regardless of modifications to equipment. With more and more demands placed on a younger crew force, removing the extra crewmember for economic reasons might task saturate the others to the point of possible fatal mistakes being made if training and equipment are not kept current.

Summary

The decision to install the navigator seat on the E-3, according to Boeing instructors, was due to the critical nature of the mission. The future decision to remove the E-3 navigator was equally as critical and centered mainly on economic concerns. Initially, the high value $135 million aircraft required a navigator due to the unreliable systems aboard the E-3 at the time. The INS drift rate and the OMEGA receiver induced error into the navigation computer due to atmospheric conditions such as solar flares, which raised and lowered the ionosphere affecting LF signal strength. The navigator was needed to verify through any means available (mainly celestial navigation over water) the information going into these systems was correct, to preclude errors transmitted to the mission radar. If poor position fixes were induced into the mission equipment, the

resulting position of aircraft seen on the mission radar would be erroneous by the same amount of difference present in the INS equipment. Basically, the mission of the E-3 could not afford such a navigation error due to the nature of the mission. As the technology advanced to GPS, and the accuracy increased, the navigator became more of a systems monitor on the E-3 and less challenged. This situation resulted in boredom and job dissatisfaction from the E-3 navigators' perspective. However, compared to the KC-135 community, the E-3 navigator still had fewer problems.

The KC-135 started the Pacer Crag navigation systems modification in 1994, and the Air Mobility Command (AMC) commander immediately removed the navigator because of a projected navigator shortage in other aircraft to include the E-3 (Poindexter, 1994). This initially caused a great deal of problems in the KC-135 community, resulting in navigators being returned to the KC-135 until the technology for Pacer Crag could be made more reliable. The KC-10 never put a navigator on the aircraft due to one senior ranking individual in the Pentagon simply red lining through the position (Interview with Colonel Mark M. Tarpley, 552nd ACW Inspector General, December, 1997). The KC-10 crews had similar navigation and task saturation problems until the crews could train to a three-person crew concept (Telephone Interview with a KC-10 aircrew, June, 1997).

The airlift navigator was also removed from the cockpit as the navigation systems improved (Moeller, 1976). The nature of their mission required them only on low level missions requiring cargo airdrop operations (Moeller, 1976). Navigators in the airlift community, however, would not fly on other cargo carrying missions that off loaded cargo at a base or airport due to the routine commercial nature of this mission (Moeller, 1976).

However, the bomber, fighter, and electronic warfare navigators were still used extensively, and there was nothing routine about their mission scenarios.

Even though computer systems had improved extensively, the "shooter" navigator, or a navigator who actually employed or shot or dropped weapons from a fighter or bomber, was still needed, again due to the critical nature of the mission (Denney, 1990). Eventually, even the "shooter" navigator will lose his or her job as older weapon systems such as the B-52 are retired and more advancements are made in weapons technology (Denney, 1990). The B-2 Stealth bomber is an example of state-of-the-art air weaponry, crewed by two pilots (originally planned for a pilot and a weapons system officer (WSO)) (Denney, 1990), which performed brilliantly in combat operations during the Kosovo campaign.

Even though the navigator need in the Air Force was decreasing, the retention rate in 1997 was still higher than the pilots at 70%, according to the AMC Chief of Aircrew Management in an interview during October 1997. One reason for this was that most pilots struggled with the draw of a lucrative airline salary in place of a high operations tempo and long family separation (Gambrell, 1973). This, coupled with a pilot bonus and a higher promotion rate, affected the morale of the navigator negatively (Urban, 1989).

The morale of the E-3 navigator was one of the main areas of concern in this study. One of the key problems for navigator retention and morale was initially the fact that, by law, the navigator could not command a flying squadron (Care, 1972). This was eventually repealed, but the navigator in most wings got few offers to command a squadron. However, the 552nd ACW had historically employed several navigator squadron commanders (AWACS Archives, 1999). Since the beginning of the E-3 AWACS

operations in 1977, three navigators had been entrusted with commanding an AWACS squadron and only one had commanded an operational combat squadron (AWACS Archives, 1999).

The primary question this study addressed was whether the need for the navigator still existed in the E-3. The 552nd ACW commander, at the time of this study, stated in his first navigator meeting in March 1999 that it was more an economic question than any other concern that would eventually remove the navigator from the E-3. The GINS system proved that the navigator was not needed as much if the equipment worked correctly and the pilots were comfortable enough with the system to work around in-flight problems. The trouble was that the pilot experience level in AWACS was low and the GINS training was not consistent among pilots; therefore, not all pilots had the same capability to operate the GINS without the help of the navigator. Additionally, most pilots felt uncomfortable with their training and stated additional training was needed on GINS before the navigator should be removed. The KC-135 Pacer Crag problem of premature navigator removal, which jeopardized safety in that aircraft, was not acceptable to the pilots and navigators of the E-3.

CHAPTER III

METHODOLOGY AND PROCEDURES

The purpose of this research was to determine whether or not the utility of the navigator has passed in the E-3 Airborne Warning and Control System (AWACS) due to the installation of GPS technology. This study provides a history of the E-3 navigator, compares and contrasts the current utilization of both the E-3 navigator and those experienced in other major U.S. Air Force weapon systems, highlights some perception, morale, and retention problems now present in the navigator force, and addresses whether the E-3 navigator has a future in the system. Finally, the study surveyed the E-3 navigator and pilot community, to determine if they both feel confident enough in the new GPS system to remove the navigator.

The Population

The original population of this study consisted of 137 active duty E-3 navigators and pilots assigned to the 552nd ACW. Four surveys were returned to sender during the initial mailing signifying those individuals were unavailable thus reducing the population to 133. Therefore, N = 133 pilots and navigators. Only three (3) pilot and navigator officers were excluded from the study: (1) the 552nd ACW Commander; (2) the 552nd Operations Group Commander; and (3) the researcher. These exclusions were needed to

avoid researcher bias to give more weight to survey answers given by those individuals. The sample size of 100 was chosen to provide a 95% probability of matching the population of 133 eligible pilots and navigators (Key, 1997) in the 552nd ACW. To facilitate and enhance an adequate return of the survey, 137 surveys were distributed (114 mailed and 23 distributed in the validation study). A total of 114 were mailed initially in May 1999, followed by a second mailing of 86. This second mailing was completed to increase the opportunity for those unable to respond by the initial deadline of the first mailing. This was necessary due to non-availability of pilots and navigators during the first period due to wartime contingency deployments overseas. In the general population (excluding validation study pilots and navigators) there were 58 pilots ($n = 58$) and 56 navigators ($n = 56$) using a nominal scale. The survey (Approved by Institutional Review Board # ED-99-100, p. 67 of this study) attempted to gather data on 100 available GPS/GINS qualified E-3 navigators and pilots assigned to the 552 Air Control Wing at Tinker AFB, Oklahoma. This recommended sample size (Key, 1997) ensured there was an adequate representation of all levels of responsibility and interpretation, from the most junior line second lieutenant navigator and pilot to the most senior lieutenant colonel staff officers in the aforementioned ratings. Additionally, interviews outside the population of 133 included staff officers at higher headquarters level who had flown the E-3 and were familiar with issues related to system modifications and crew composition. Additionally, pilots, navigators, and other crewmembers from other weapon systems were utilized to gain a more thorough understanding of roles, missions, and utilization of the navigator in those weapon systems. Finally, one individual

was interviewed from each of the other weapon systems employing the navigator to sample their perceptions of the issues dealt with in the study.

Survey and Data Collection

This survey was completed with two mailings and a validation study. Part one, or the validation survey, was conducted on April 12, 1999, with instructor and evaluator pilots and navigators from the 966th Airborne Air Control Squadron (AACS), Tinker AFB, Oklahoma. The 966th AACS is a highly experienced training squadron with the primary responsibility of training new pilots and navigators entering the E-3 AWACS weapon system. The Director of Operations for the 966 AACS squadron utilized the instructor experience to determine if the survey was effective in gathering the data intended for the study. There were 23 available pilots and navigators in the 966th AACS surveyed.

It is essential at this point to define the terms *total* and *general population,* which will be used later to identify sub groups. Specifically, *general population* is used to refer to *all* pilots and navigators in the study to *exclude* the 966 AACS validation study numbers. The word *total* refers to all pilots and/or navigators in the study to *include* the 966 AACS. Also, when the words *validation study* are used together in a sentence, the statement refers to the initial study conducted in the 966 AACS for pilots and navigators.

The survey was developed by the researcher and reviewed by committee members. The survey sought data regarding the following:

1. What are the perception of the pilots and navigators concerning, morale, and retention.
2. Is there still a need for the E-3 navigator-why or why not?

3. How confident are the pilots and navigators with the training they received, general operational characteristics of the GPS modified E-3, and are the pilots ready to fly solo?
4. Should the navigator stay onboard?
5. Will safety be compromised?

The survey was designed to provide anonymous input by the individuals participating in the study. The surveys were conducted in the form of a structured questionnaire. Telephone or personal interviews of individuals outside the 552nd ACW were utilized to enhance the study. Responses were recorded, categorized, and tabulated for easy understanding.

The information sought was primarily descriptive in nature and designed to gather tabular data to measure central tendency.

Limitations

The study was limited to historical and empirical information related to one specific weapon system and one specific crew position within that system, the navigator. As a necessity, pilots were surveyed due to the close working relationship between them and the navigator community in the E-3. Additionally, due to the many-faceted aspects of the navigator question within the U.S. Air Force, other weapon system managers, particularly those who have removed navigators (KC-135, KC-10, C-5 and C-141), were interviewed to allow the researcher to gain a broader perspective of the successes and failures of this personnel action within the Air Force.

Analysis of the Data

Responses to the interviews and questionnaires were gathered and summarized. Primarily, empirical observation and experience were used to interpret the data. Since this can be both an advantage and a disadvantage to interpreting the data objectively, respondent answers were tabulated as a quantified percentage. Responses were categorized by rank, level of E-3 experience, and whether the individual was a staff or line officer.

Instrument

See Appendix B of this study, which provides the instrument used to survey the rated pilots and navigators of the 552nd Air Control Wing.

CHAPTER IV

FINDINGS

Demographic Data

The purpose of this study was to provide a brief history of the U.S. Air Force AWACS E-3 navigator, describe the perception, morale and retention problems generated by the Air Force human resource management initiatives toward the navigator, and determine if pilots and navigators within the AWACS weapons system perceive a need for the navigator after the GPS/GINS modification is complete.

The review of the literature provided a history of the E-3 navigator, described the utilization characteristics of the U.S. Air Force navigator in general, highlighted and described some perception, morale, and retention problems associated with human resource management initiatives toward the navigator and pilot, and determined if pilots and navigators within the AWACS perceived the need for the navigator after GPS modification was complete.

This last objective started with the validation study and a total of 23 available pilots and navigators. Specifically, 15 pilots and 8 navigators were available for the validation study, of which 10 pilots and 7 navigators responded for a total response rate of 74%. By comparison, the response rate for the general population pilots surveyed (42 of 58 or 72%) and navigators surveyed (37 of 56 or 66%) approximated the above overall

validation study rate. During the survey sample size of 100 pilots and navigators, a total of 33 responded to the first mailing of 114 surveys. The second mailing of 86 resulted in a total of 29 responses. Counting the 17 respondents of the validation study, the total 79 respondents (33 + 29 + 17) resulted in an overall response rate of 79% for a sample size of 100.

An "eligible" pilot or navigator was defined as one that was qualified in the E-3 AWACS as either a pilot or navigator, and was not a Wing or Group commander, or the researcher. The Department of Defense determined the exact number of pilots and navigators assigned in the 552nd ACW as classified information and therefore it cannot be revealed in this study. The data in Table I shows the distribution of the sample respondents relative to the total population for rank and crew position.

The data in Table I, illustrates that the grade distribution percentage between pilots and navigators was notably different. While the pilots had no second or first lieutenants in the sample size, the navigators had 26, which accounted for 33% of navigator respondents. Pilot and navigator captain respondent percentages were exactly the same. Specifically, 63% of the captain pilots (26 of 41) responded to the survey, compared to 63% of the captain navigators (17 of 27). In the field grade officer category (major through lieutenant colonel) 60% of the pilot majors (9 of 15) responded to the survey, compared to 100% of the navigator majors (4 of 4). A similar respondent rate difference was noted between lieutenant colonel pilots and navigators. A total of 50% of the lieutenant colonel pilots responded to the survey (7 of 14) compared to 100% of the lieutenant colonel navigators (6 of 6).

TABLE I

SAMPLE RESPONDENTS ® VERSUS POPULATION DISTRIBUTIONS

	Sample ® %	Population (N=133)
Grade Distribution (Pilot)		
Captain (Capt)	59	41
Major (Maj)	21	15
Lieutenant Colonel (Lt Col)	20	14
Grade Distribution (Navigator)		
2nd Lieutenant (Lt)	3	2
1st Lt	38	24
Capt	43	27
Major	6	4
Lt Col	10	6

Even though the response rate was significantly different between pilots and navigators in the rank or grade between majors and lieutenant colonels, the total response rate for pilots and navigators was within two percentage points. Specifically, the pilot response rate was 46% (32 of 70 eligible) compared to the navigator total response rate of 48% (30 of 63 eligible).

Survey Results

Overall, the response rate was 72% for all pilots surveyed and 66% for all navigators surveyed. A total experience rate of 4.19 years for pilots and 3.43 years for navigators indicates a relatively young crew force existed in the 552 Air Control Wing

(ACW) during the study. The total percentages revealed 66% of pilots were experienced as compared to only 43% of the navigators. The total population surveyed revealed 19% B-52, 12% KC/RC/EC-135, and 10% fighter when the T-37 and T-38 jet trainers are excluded (See Appendix E for details and comparison percentages between validation study, general population, and total population).

The survey also determined whether a pilot or navigator was a line or a staff officer. A line officer is defined as an officer whose primary responsibility is flying missions in the AWACS E-3 aircraft on worldwide missions, while a staff officer's primary duty is working in a staff capacity, flying only to stay current and proficient in the aircraft. This differentiation, line versus staff, is used to illustrate a percentage of perception revealed in the survey results. Specifically, staff officers may not perceive a problem as readily, based on their lack of hands-on contact with the weapons system day-to-day, where conversely the line officer may be more perceptive due to day-to-day exposure to the system. As an example, if there were a large percentage of staff influence in this study, it may indicate to someone reviewing this work that a staff or management viewpoint could have skewed the percentage a certain direction versus percentages representing a true line or worker perspective. Total line pilot percentages revealed 80% and total navigator percentages were 76%. This illustrates management or "staff" was represented in the results but did not have a large influence on the percentages. It also illustrates that pilot opportunities on the staff were less prevalent at the time of this study (19%) than the navigator staff opportunities (24%).

The data in Table II (See Appendix E) illustrates a comparison of perceptions concerning opportunities to advance in AWACS in the validation study and the same

comparison in the general population (excluding 966 AACS validation study), and total population (including 966 AACS validation study). This perception provided the first insight into perception, morale, and retention possibilities for both pilots and navigators. Pilots generally had a higher perception of advancement opportunities in AWACS, which attributes to the overall morale and retention of both. Percentages for total population are reflected in the data in Table II below.

TABLE II

AWACS OPPORTUNITY FOR ADVANCEMENT
VALIDATION STUDY VERSUS GENERAL
POPULATION PERCEPTION

Crew position	High %	Average %	Low %	Unknown %
Total Population				
Pilot	43	17	29	10
Navigator	32	19	38	11

As the data in Table II illustrates, the pilots' outlook on advancement opportunity was higher (43% versus 32%) than the navigators' outlook when considering the total population perception. The data in Table II also illustrates few pilots and navigators view advancement in AWACS as average (within 3 percentage points) (17% for pilot versus 19% for navigator). According to the survey results, a contributing factor to the low perception for advancement opportunity in AWACS could possibly have been attributed

to lack of career counseling. The total percentages revealed 43% of pilots did receive career counseling and 57% of the navigators received guidance from senior leaders concerning careers. Overall counseling did not seem to be a notable factor in the morale of both pilots and navigators. (See Appendix E for detailed comparisons of pilots and navigators in the validation study and general population)

Career counseling comes in many forms, some from senior officers (lieutenant colonel and above). The study attempted to determine at what level the career counseling extended. To put the pilot counseling into perspective, by nature of the pilot's responsibility most receive daily feedback from senior officers, whereas other crew positions tend to receive feedback only from the pilot. Total counseling statistics depict close comparisons for pilots overall at 52% and 59% for navigators.

Along with career counseling from senior officers and supervisors, the survey attempted to determine if counseling was being passed down from the level of those surveyed to other subordinate personnel in the form of mentorship. Total affirmative pilot response to mentor duties was 86% and total navigator response was close at 81%. (See Appendix E for detailed comparisons of validation study, general population, and total population)

Empirical knowledge deemed it important to illustrate how training standardization or the lack thereof fostered feelings of adequacy or inadequacy. Inadequacy in training and proficiency would naturally reduce the level of mentorship in the wing. The data in Table E-III (See Appendix E) illustrates the variation of training methods utilized in AWACS during a software modification called 30/35, which included the Global Positioning System (GPS) Integrated Navigation System or GINS. The general pilot population revealed 72%

inadequate rate in their GINS training compared to the general navigator population who reported less inadequate training at 57%.

A second objective of the survey was to determine if there was still a need for the navigator on the E-3. First, pilots and navigators were asked to reveal their views on whether or not they felt their skills as a pilot or navigator were utilized effectively with the new technology being introduced to the E-3 AWACS. Through empirical observation for over three years, most pilots and navigators were observed in flight to be somewhat complacent with the new GINS technology and subsequently seemed under-challenged in the job. (See Table E-IV in Appendix E for an illustration and comparison of the percentages from the pilots and navigators in the validation study and those in the general population) The total respondent pilots felt the E-3 provided *good* utilization of skills at a rate of 45%, compared to navigators who rated skill utilization as *good* at 32%; total pilot response rated skill utilization as *average* at a rate of 26% compared to navigators *average* rating at 32%; total pilot response for a *poor* utilization of skills was at 26% compared to navigators who rated skill utilization as *poor* at a rate of 30%; and *unknown* ratings were at 2% and 5% for pilots and navigators respectively.

Next, survey respondents were asked their intentions concerning a career in the active Air Force. Comparisons of answers from validation study pilots and navigators and general population operational pilots and navigators can be found in Appendix E. Overall, 33% of the pilots said *yes* to staying in the Air Force; 48% said *no* to a career; and 17% were undecided. Additionally, 7% of those indicating they would not stay in the Air Force did express an interest in the Air Force Reserves to keep some contact with military flying. Some of this desire to remain in aviation can probably be attributed to "the love of flying."

In a research study completed by Major Charles Gambrell in 1973, he found that pilots in their first four years (0 to 4) rated "love of flying" as their number one motivator at 39%. As pilots progressed to the second four years (4 to 8) this percentage dropped only to 34%. Gambrell also found in the same study that navigators "love of flying" was rated number one at a rate of 26% during the first four years (0 to 4) but dropped notably to 7% during the second four year range (4 to 8). The AWACS navigators overall were planning to stay Air Force at a rate of 59%; 24% said they would leave the service; and 16% were still undecided. The larger percentage of undecided navigators can be understood since 10 lieutenant navigators responded to the survey versus none of the pilots. Typically, lieutenants have not reached the career decision point before they are promoted to captain at the four-year point.

At this point the research led the survey respondent through personnel subjects concerning job satisfaction. Overall, 81% of the pilots indicated they were satisfied with their jobs and only 19% indicated they were not satisfied. On the navigator side, 76% indicated they were satisfied but 22% responded they were not satisfied with their work. See Appendix E for details concerning job satisfaction or enjoyment comparisons between the validation study pilots and navigators and the general population pilots and navigators.

The survey then narrowed the focus of the respondents and asked them to specify exactly what should be done with the navigator once the 30/35 GINS software modification is complete. Specifically, Table III (and the expanded and detailed version Table E-V in Appendix E) illustrates a basic response concerning the question of whether there is a need for the navigator, should they stay or go from the E-3, and should the Air Force use their talents elsewhere. Overall, according to the survey results and the data in

Table III (E-V in Appendix E), a notable majority of respondents thought the navigator should stay.

TABLE III

KEEP VERSUS REMOVE E-3 NAVIGATORS

Study Group/	Pilot %	Navigator %
Keep Navigator	69	46
Remove Navigator	15	43
Unknown	15	11

As the survey respondents progressed to the end of the survey, they were again asked to assess in general terms whether or not they perceived upward mobility to be a problem in AWACS, and in the Air Force. Overall, the total pilot response was 60% considered upward mobility difficult in AWACS and 29% thought it was not difficult. The pilots overall seemed more optimistic about their chances for upward mobility in the Air Force when only 31% responded that they thought it was difficult and 45% thought it was not difficult. The total navigator response was notably different. A total of 68% of the navigators responded that AWACS upward mobility was difficult while 30% thought it was not difficult in the organization. The navigators also thought that upward mobility was difficult in the Air Force at 70%, while only 16% thought it was easier to move up in

the Air Force. Overall, the navigators seemed less confident about the upward mobility prospects in AWACS and the Air Force compared to the pilots.

The most prevalent comment concerning upward mobility opportunity in AWACS was that the career officer 13B Air Battle Manager (ABM) was taking all the leadership opportunity away from the pilot and navigator in AWACS. A total of 34% of the negative comments in the general population surveys concerning upward mobility in AWACS dealt with the qualification of the 13B officer to hold key leadership positions. Initially, eligibility to command Air Force flying units was restricted to pilots by Title 10, United States Code, Chapter 845, Section 8577, which was enacted into law on August 10, 1956 (Care, 1972). The law was later repealed on December 18, 1974, to allow navigators to command flying squadrons (Cook, 1976). The decision was not popular with the pilots at the time but eventually was accepted. In late 1996 the law was repealed again to allow 13B mission crew commanders (MCC) to command AWACS flying squadrons (AWACS Archives, 1996). AWACS pilots and navigators went through the same objection, as did the pilots in 1974, when they both witnessed 13B career officers taking command of flying squadrons.

The last two survey questions were utilized to address the perception of a need for the navigator, the confidence level of the pilots without the navigator, and whether safety will be a factor if the navigator is removed. Overall, pilots thought the E-3 operation would be safe without the navigator at a rate of 64%, while 31% of the pilots disagreed, responding that the operation would be unsafe. The total navigator respondent indication was that 54% thought the E-3 operation would be safe without them and 46% thought it would be unsafe to fly without the navigator position occupied. Appendix E provides

specific comparisons between the validation study and the general operational population pilot and navigator.

The last survey question continued the safety theme and asked respondents to list their perception of future E-3 safety factors with and without the navigator. Table E-VI in Appendix E illustrates the results of this response, compares the validation study to the general population results, and reveals specific issues of aircrew perception on whether the removal of the navigator would compromise safety. Overall, the top pilot concern without the navigator was training at 25% and navigators' top concern was crew resource management at 37%.

During the survey period 114 surveys were initially mailed which resulted in 33 respondents (17 pilots and 16 navigators). The second mailing of 86 surveys resulted in 29 additional respondents (15 pilots and 14 navigators). Pilot response rate for the first mailing was 29% and climbed to 37% for the second mailing. The navigator response rate was 29% for the first mailing and climbed to 35% for the second mailing. Table E-VII in Appendix E illustrates the similarities and differences between the respondents of the two mailings.

CHAPTER V

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Introduction

The purpose of this study was to determine the usefulness of the military navigator, particularly the E-3 navigator, with the improvements made to navigation technology. The objectives were to provide a brief history of the U.S. Air Force E-3 AWACS navigator, describe the perception, morale, and retention problems generated by the Air Force human resource management initiatives toward the navigator, and finally determine if pilots and navigators within the AWACS system perceive a need for the navigator after GPS/GINS modification is complete.

Review of the Literature discussed the history of the navigator in the E-3 and how that crew position was added to the crew complement. Civilian airliners went through great controversy about whether or not to use a navigator because of safety and economic concerns (Komons, 1987). After the Federal Aviation Agency authorized Trans World Airlines (TWA) to use a new Doppler navigation system over the Atlantic in February 1962, the civilian airline navigator position had reached the end of its usefulness. However, the Air Force could not afford to lose the E-3 to a careless navigation mistake in light of the fact that the E-3 had historically always been flown by pilots much less experienced than those in the airline industry. According to an unpublished 965 AACS

pilot data sheet dated September 23, 1999, the average AWACS E-3 aircraft commander in one operational squadron, at the time of this study, had 852.25 hours. This lack of pilot experience warranted the perceived need by the Air Force for that "extra set of eyes" in the cockpit to offset the low experience levels.

As the Soviet threat diminished and Cold War ended, the "doomsday" mentality began to retreat into history. This, coupled with the Global Positioning System (GPS) satellites and state-of-the-art navigation and avionics technology, resulted in removal of the navigator in the KC-10 Extender, KC-135 Stratotanker, the C-5 Galaxy, and the C-141 Starlifter. Additionally, Air Force leaders removed one of the two navigators in the RC-135 reconnaissance aircraft due to the confidence in new navigation systems. The RC-135 aircraft mission had a long-standing need and tradition of utilizing two navigators who sat side by side to handle the complexity and absolute precise position requirement of the aircraft. The B-52 Stratofortress has also removed one of two navigators due to the advancements made in weapons technology which utilizes GPS technology. Fighter aircraft are now being built like the F-22 for the next century employment without the second seat for the Weapons System Officer (WSO), again due to the advancement of weapons technology.

Over the horizon lies the concept of "Freeflight" navigation and termination of ground based navigation aids like TACAN and VORTAC systems. This concept, once executed, will result in total reliance on space based navigation systems to select more direct routing to destinations, resulting in increased savings in time, fuel, and money. The commander of the 552 Air Control Wing (ACW), Brigadier General Lee McFann, stated in a navigator meeting on March 15, 1999 that "The decision to remove the navigator

from the E-3 was an economic decision." As a participant of this historical meeting, the researcher noted that this was the first time most had heard senior general officer leadership in the Air Force articulate that the beginning of the end for the E-3 navigator had arrived. Major Bill Tully of Air Combat Command (ACC) stated in a personal interview in August 1999 that the removal of the E-3 navigator was already being budgeted for 2003, with completion scheduled for approximately 2010.

The morale and retention problem for navigators has been on the rise over the years with the increased utilization of the GPS technology and the modification of all Air Force weapons systems. To add to the problem of morale, navigators typically get promoted at a lower rate than pilots or 13B career officers. Additionally, as of October 1, 1999, the rated officer status that was once exclusive only to pilots and navigators included all 13B career fields too. This increased the competition for command billets by one third in the AWACS community. Furthermore, during the navigator shortage in 1994 through 1998 many AWACS field grade navigators (major through lieutenant colonel) were taken from the ranks of the Air Force staff to return to the cockpit and fly due to navigator mismanagement. Empirical observation noted chronic morale problems in the AWACS navigator force for several years (1996-1999). This was coupled with the fact that bonuses for shortage career fields such as pilots never applied to navigators. Morale of the navigator force and the pilot force has now become one of the most acute problems in the AWACS community. AWACS leadership continues to struggle daily to maintain a viable fighting force and foster high morale that will be absolutely necessary for the combat challenges of the 21st century.

Summary of Findings

Analysis of the 100-person sample size resulted in a 79% rate of return on the 18-question survey. However, one validation study and two mailing attempts were needed for the 79% return rate. A total of 42 pilots and 37 navigators responded to the survey, which equated to a 72% response rate for pilots and a 66% response rate for navigators. The average pilot had 4.19 years of service and the average navigator had 3.59 years. Pilots were 67% experienced in other aircraft while navigators were only 43% experienced. Most previous experience was B-52 (19%) and KC-135 series (27%). Pilots were 80% line officers while navigators were slightly less at 76%. Pilots in general thought opportunities for advancement were higher at 43% than navigators at 32%. Pilots did not receive as much counseling in AWACS (43%) as navigators (57%). Also, pilots were slightly less likely to receive guidance from senior officers at 52% than navigators were at 59%. However, pilots by nature of their responsibilities mentored more people at 86% than navigators at 81%. The majority of pilots received 30/35 GINS training through aircraft on-the-job training during E-3 missions (48%), while navigators used the same methods at a rate of 41%. The initial training received by pilots was thought to be inadequate at a rate of 69%, and navigators were in close agreement at 62%. However, 45% of the pilots thought the flying skills they had developed over the years of service were well utilized on the E-3, while navigators in general had a 32% satisfaction rate with their skill utilization on the E-3.

The retention problem for pilots in the military was well documented in numerous articles and held true in AWACS when only 33% indicated they would stay in the Air

Force, while 48% indicated they would leave after their commitment. This left 17% undecided and 7% with intentions to go to the reserve forces. The most prevalent reason most had decided to leave was not attributed to money but to the added stress on family life that is inherent to a military career. The navigator retention indication in AWACS was surprisingly high even with the news of their pending removal from AWACS. In the survey, the AWACS navigators stated they intended to stay at a rate of 59%. Only 24% of navigators indicated they would leave, and 16% were undecided. It was also revealed in the survey that job satisfaction was not the reason that most were leaving the U.S. Air Force. The AWACS pilots were 81% satisfied with their jobs, and navigators were rated slightly less at 76%.

One of the main concerns of the survey was to determine what those flying AWACS thought should be done with the navigator once the 30/35 GINS modification was complete. The pilots were 69% convinced that the navigator should stay on the aircraft, but only 44% of the navigators thought their continued presence on the E-3 was necessary.

Upward mobility in AWACS seemed to be a concern for a majority of pilots and navigators. Pilots revealed that 60% thought upward mobility to be a problem of concern in AWACS, mainly due to the recent trend to place non-pilots in command positions. Of the six operational squadrons, only one commander was a pilot, and that individual at the time of this study was in a flying training squadron as opposed to an operational combat flying squadron. There were three commanders who were MCCs and two commanders who were navigators. Again, a main pilot concern was there were no pilot commanders in operational combat flying squadrons at the time this study was conducted, which was

attributed to the pilot dissatisfaction with opportunities for upward mobility. Even though there were two commander navigators in AWACS at the completion of this research (none at the time of the survey), the navigators were surprisingly more discouraged with AWACS upward mobility by indicating a 68% consensus of dissatisfaction. Specifically, it was the general navigator perception that it was more difficult to move up in AWACS. Only 31% of the pilots thought it was difficult for a pilot to advance in the Air Force, but navigators were 70% convinced that upward mobility was tougher for the navigator in the Air Force.

Next, the survey addressed the safety question and asked pilots and navigators if safety would be an issue if navigators were removed. Pilots and navigators both thought the E-3 could maintain its good safety record. Pilots indicated at a rate of 64% that the E-3 would be safe without the navigator, provided both pilots and flight engineers received appropriate levels of training. The navigators too thought the E-3 would still be safe at a rate of 54%. Finally, the survey asked respondents to list future safety factors of concern with and without the navigator. The pilots were concerned about work distribution at 10%, experience, and situation awareness, both at 7% with the navigator still onboard the E-3. Without the navigator, the pilots were mostly concerned about pilot and flight engineer training needs at 31%, followed by experience loss at 24%, and crew resource management at 21% as the top three concerns. The navigators overall had no "with navigator" concerns, but listed crew resource management (CRM) as their number one concern at 38%, followed by increased workload for the pilots and flight engineers at a rate of 27%, and finally equipment malfunction and mission planning at 19%.

A final subjective assessment was made of the survey in its entirety to determine, based on the tone of the answers received, the overall morale of the 552 ACW pilots and navigators. The assessment could not be quantified based on a scale but, using empirical data based on 17 years AWACS experience, and familiarity with most of these individuals surveyed, an assessment could be made based purely on writing tone and observed attitudes of respondents. These attitudes were also known through discussions with supervisors and commanders.

The 966 AACS validation study assessed the pilot morale to be 20% high, 30% average, and 50% low; the validation study navigator morale was only slightly different at 29% high, 14% average, and 57% low. The general population pilot had better morale assessed at 34% high, 34% average, and 25% low. General population navigators showed high morale at 60%, 20% average, and 17% low. Unfortunately, it was determined that 6% of the general pilots and 3% of the general navigator responses could not be interpreted to fit any morale category due to the lack of identifiable tone in their answers. Overall, the pilots were 31% in a high morale state, 33% average, and 31% low morale. The navigators were looking better at 54% high morale, 19% average morale, and 24% low morale.

Conclusions and Recommendations

The U. S. Air Force navigator has served and continues to serve professionally and proudly alongside his or her pilot counterpart. The increased technology installed in civilian and military aircraft have made it necessary to revise, retrain, and reorganize the way we do business in the civilian and military aviation environment. Since the entire

aviation community, both civilian and military, must share the same airspace, it is essential that all have similar technological capabilities. The crowded skies require precise positioning and timing to save time, fuel, and money. It is therefore essential that all aviation entities move forward, which means modifying existing aircraft, restructuring and retraining crews, and building new aircraft with precise positioning capabilities.

The military navigator served a unique purpose for many years when there was no technology comparable to that used in 1999. The human navigator was the flight computer of yesterday, utilizing celestial navigation, timing, dead reckoning techniques, pressure line of position, and many more to get the mission complete. The navigator was the redundant or backup system for the pilots due to the complexity of the aircraft, with the flexibility to adapt to almost any situation. Now, with the advent of Global Positioning System (GPS), advanced laser gyros for inertial navigation systems, and glass cockpits to facilitate pilot crosschecks, the human navigators find that they are under-utilized when the equipment works well.

Air Force leaders have moved forward with technology to economize the staffing requirements and modernize the cockpits to enhance weapon precision. Precision Guided Munitions (PGMs), which utilize GPS, have been targeted with such accuracy that air campaigns such as Desert Storm and Kosovo almost eliminated the need for pilots and crews to fly over a target to bomb that target. This saves lives and equipment by limiting the number of people the military needs to send in harm's way or expose to the hazards of combat. Some of the weapon systems in the Air Force therefore have been upgraded to preclude the need to send unnecessary people into battle.

Unfortunately, the removal of the navigator from some weapon systems such as the C-5, C-141, KC-135, RC-135, C-130J, and KC-10 had its effect on morale and retention. During the initial removal of the navigator in the aforementioned systems there were some initial growing pains. Also, training of those pilot and flight engineer crewmembers left behind seemed to lag behind the decision to remove the navigator. The case in point mentioned earlier was the mistake made during the KC-135 Pacer Crag program which removed the navigator prematurely and had to subsequently recall the navigator force back to the KC-135 cockpit until technology and training could be re-integrated correctly (Poindexter, 1994). At the time this study was completed, the KC-135 Pacer Crag system had since been modified, and training in the aircraft for pilots had been integrated correctly, thus subsequently eliminating most of the early problems in 1994 (personal interview with associate program manager Lt. Col John Ide, previously of Air Mobility Command Headquarters, April 1999).

Air Force leaders at Air Combat Command (ACC) and the Pentagon have already started the budget process of modernizing the avionics in the E-3 to facilitate removal of the navigator completely in approximately 10 years (interview with Major Bill Tully, August 1999, Air Combat Command Headquarters). However, morale and retention for the E-3 navigator have not been as affected as compared to the pilot. This is primarily due to the high operations tempo overseas and the hiring boom by the airlines over the past several years. Many crewmembers in AWACS are away from home in excess of 120 days per year and some as many as 200 days per year. That heavy temporary duty (TDY) load has had a tremendous effect on morale and retention throughout the Air Force and

AWACS specifically. Surprisingly, there are still those who continue flying military due to the love of mission and country.

The navigator will continue to be utilized in some bomber, fighter, and special operations aircraft well into the 21st century, but the E-3 navigator days are numbered. The wheels have been put into motion to remove the navigator from the AWACS by approximately 2010, depending on funding for depot avionics modifications and training for pilots. If the navigator phase-out is done correctly, morale, retention, and safety will not be jeopardized. There are other jobs in the Air Force for navigators. If AWACS provides good career counseling and practices good human resource management techniques, the navigator retention will continue to climb above 59%, as stated in the survey results, until a safe transition can be made to a three person cockpit as that crew position is phased out.

AWACS leaders must also ensure training for pilots and flight engineers will be in place before the last navigator leaves the weapon system. Over 69% of the pilots and 62% of the navigators felt their initial conversion training to GINS was not adequate. The E-3 leadership cannot afford to allow the navigator removal to cause it to stumble like the initial Pacer Crag program and risk losing an aircraft and crew due to some careless mistake of aviation or navigation. Over 69% of the E-3 pilots want to keep the navigator on the aircraft, but 64% think the E-3 will be safe without a navigator. However, many of those respondents cautioned that the pilots must receive adequate training prior to the last navigator's departure.

AWACS leaders must watch the experience levels of pilots. Before the fourth person is removed from the E-3 cockpit, the pilot experience level should be increased.

This is no easy task. All leadership in AWACS and the Air Force must concentrate on keeping the best and the brightest in the service of our country. Retention has been a problem for years in the Air Force, and the airline industry promises a better lifestyle with better benefits and better family life. To keep quality people in the Air Force and build the experience level, the armed forces must take care of their people and provide a competitive benefit package comparable to the airline industry. Most pilots and navigators are not as concerned about money as knowing that when they are serving their country overseas, their families will receive first class care if needed.

Should the navigator stay? In my opinion, my empirical knowledge with the GINS and discussion with other crews who fly the E-3 have convinced me that the navigator should stay on the E-3 for a while longer. This is not because I happen to be an E-3 navigator but is due primarily to the experience level of the crews as of the date of this study and the minimal training received on the GINS system thus far. Many of the most experienced aircraft commanders have only a few hundred hours, whereas, when I first came to AWACS in 1982, most had 3000-5000 hours.

The E-3 navigator has served with distinction over the years. It is my educated opinion and recommendation that the navigator should stay in the E-3 due to the experience level of our crew force and the critical nature of our mission. One E-3 lost creates a tremendous void in our force which money cannot replace. If economics determines the removal of the navigator, several things must occur. Training must be revamped to be more challenging for the pilots, and money must be spent on simulators to introduce wartime scenarios that a three-person team (pilot, co-pilot, and flight engineer) will possibly encounter to prepare for that likelihood. When navigators are eventually

removed, the Air Force should gradually remove them to avoid a shock similar to that experienced by the KC-135 community.

Implications for Further Study

This study provided a brief history of the U.S. Air Force navigator role in other weapons systems, and specifically the E-3 AWACS. The study described morale and retention problems generated by human resource management initiatives toward the navigator, introduced Air Force leaders' concerns with staffing and economy in light of introduction of new technology, and provided a 79% sample of the views of pilots and navigators who staff and fly the system.

Further study of the relationship between navigator and pilot retention and benefits is appropriate. Such studies could unlock the secret into what makes people sacrifice a more comfortable lifestyle in the civilian sector to fly in the military. Analyzing how people are motivated to stay in the Air Force will enhance keeping the right people to defend the country in the future. Similar studies need to include morale. Morale is a key contributor to the departure of Air Force pilots and navigators. Most morale problems could be eliminated with supervisor attention to their needs.

It is hoped that information gathered during this research study will provide a good starting point and areas to focus on for future study and improvement. AWACS must get better at career counseling, mentorship, and system training. Additionally, the Department of Defense must ask itself if the military mission, due to its uniqueness, should be the exception to the rule when considering crew composition with the more advanced technology, or should the military go with the status quo regardless of crew experience

levels? Specifically, should the military aircrew composition mirror the civilian airliner with similar technology, or should the military consider the lower experience level of the military aviator and keep that extra set of navigator eyes in the cockpit? Also, is the military trying to answer the need for leaner budgets while unintentionally compromising training, mission, and safety? These and other concerns should be the focus of further study. Understanding the concerns of pilots and navigators will ensure their future and the future of the weapon system well into the next century.

SELECTED BIBLIOGRAPHY

Pilots Data Sheet for 965 Airborne Air Control Squadron (AACS), Sept 23, 1999. [Unpublished Raw Data].

Bowditch, N. (1984). *The American practical navigator* (Vol. 1, pp 1-5). Defense Mapping Agency Hydrographic/Topographic Center.

Care, F. J. (May, 1972). "Navigator Eligibility for Command" Unpublished. Air University Library, Maxwell Air Force Base (AFB) AL, (25).

Cook, R. O. (May, 1976). "The Navigator as Commander of a SAC Combat Aircrew" Unpublished. Air University Library, Maxwell Air Force Base (AFB), (9).

Denney, J. T., Jr., (September, 1990). "Navigator Command Potential: An analysis of U.S. Air Force Pilot Attitudes Toward the Job Satisfaction Characteristics of U.S. Air Force Navigators" (AD-A229 789). Unpublished. Air University Library, Maxwell AFB, AL, (2)(25).

Desert Storm Archives for the 552 Air Control Wing, (1991). Unpublished. Air University Library, Maxwell Air Force Base (AFB), AL.

Fogleman, R. R. (1996). [Chief of Staff Air Force policy communicated via verbal communication and email message].Unpublished.

Fulghum, D. (September 15, 1997). Flying slots disappear, shift to ground and space. *Aviation Week and Space Technology,* 72-74.

Gambrell, C. E. (May, 1973). "The Navigator Career: A Case for Revitalization" Air University Library, Maxwell AFB, AL. (22)(27).

Key, J. P. (1997). AGED 5980 Research Design. p. 79. Stillwater, OK: Oklahoma State University.

Komons, N. A. (1987). *The third man.* A history of the airline crew complement controversy 1947-1981. Department of Transportation, Federal Aviation Administration. Washington, D.C.: Library of Congress.

Kempf, M. F. (May, 1974). "The Navigator: In Command" Unpublished. Air University Library, Maxwell AFB, AL., (13).

Kotter, R. H. (May, 1976). "The Navigator: His Future Role in the Air Force" (Report No. 1941). Unpublished. Air University Library, Maxwell AFB, AL, (8 – 17).

Mission Statement from the 552 Air Control Wing (ACW), (1997). Unpublished. Tinker AFB, OK.

Moeller, K. E. (April, 1976). "The Navigator: An Endangered Species?" (Report No. 6009). Air University Library, Maxwell AFB, AL. (13, 48-49).

Nordwall, B. (December 1, 1997). Solar storms threaten GPS reception. *Aviation Week and Space Technology,* 61-62.

Poindexter, G. W. (December 12, 1994). Are navigators mistreated? *Air Force Times*, p. 1.

Semple, C. A., Jr., Heapy, R. J., Andross, N. E., & MacArgel, R. E. "Navigator-Observer Utilization Field Flying Specialties Study Appendix I. Present and Future Roles of the Navigator" (AU74-861). Air University Library, Maxwell AFB, AL, (65), 1974.

Sobel, D. (1995). *Longitude.*[Reference cited in an article cut out from a 1997 article from The Daily Oklahoman entitled *Republicans' Silence Is Puzzling* by Thomas Sowell] (no date nor page number of news paper article).

Urban, M. A. (September, 1989). "An Examination and Comparative Study of Job Characteristics Levels And Internal Work Motivation Among U.S. Air Force Navigators Based on Aircraft and Type Mission Flown" MS Thesis AFIT/GLM/LSR/89S-68. School of Systems and Logistics, Air Force Institute of Technology (Air University), Wright-Patterson AFB, OH, (4, 8,9,25).

USAF Undergraduate Navigators Training Manuals (1982). Unpublished. Mather AFB, CA.

Watkins, S. (March 27, 1995) Dangers in removing navigators? / KC-135 Tests Raise Questions. *Air Force Times*, 1.

Webster, E. H. (November, 1970). "The Navigator in Tactical Strike Aircraft" (Report No. 4258). Air University Library, Maxwell AFB, AL, (12).

APPENDIXES

APPENDIX A

COVER LETTERS

Greetings and salutations!

As an E-3 rated officer you have made an enormous impact on the security of our great country and you and your family have made numerous sacrifices over the years as a result. Since the increase of our operational tempo, I am deeply concerned that your voice has not been heard enough regarding your views of the ongoing Block 30/35 GINS modification and training. You have superbly executed the ACW's mission and your laudable safety record, while training and employing the E-3 aircraft, speaks for itself. However, you deserve a chance to express your specific concerns on several issues addressed in this questionnaire.

I am aware your time is valuable and would hope that you would take just a few minutes to answer the short attached questionnaire. This is a private study funded by myself and there is no requirement by the U. S. Air Force or any other organization for you to participate. However, your professional views are very important to me. With your help, I may be able to better inform the senior leadership on several issues to include the future utilization of the navigator in the E-3, cockpit modernization, training, safety, job restructuring, and career concerns of both pilots and navigators.

To guarantee your confidentiality you need not write your name on the completed questionnaire. However, if you would like me to share the results of this study with you after its completion please write a return home address on the questionnaire or include your name and email address. If you would like to respond by email my home electronic address is as follows: boomergatr@aol.com. Please complete and return this questionnaire or answer via email by 25 June 1999.

The data obtained from this pilot study will provide valuable insight for modifications to the questionnaire I will send to every pilot and navigator in the wing later this month. This data will also hopefully provide insight for future improvements and better prepare this system for employment in the next century. For weapon viability, the crews must be properly manned, motivated, trained, and equipped. Indicative of their concern, the 552d ACW and Operations Group commanders have given their permission for this survey and are interested in the results, your careers, and the future of this weapon system.

Once again, thank you for your time and continued dedication to the Air Force and AWACS mission. Those who will lead AWACS tomorrow must be heard today.

Keith R. Allford, Lt Col, USAF
966 AACS Director of Operations

Greetings AWACS Aviators!

The beginning of June I sent you a survey with a very short suspense of June 25, 1999. Due to the war in Europe, some of you were out of town during this period and were unable to participate. This is a second attempt to solicit your valued input before the study is complete. If you have already received and responded to this survey, thank you for your time and please ignore this reminder. If you did not get the opportunity, please complete and return this survey as soon as possible to facilitate completion of the study.

As an E-3 rated officer you have made an enormous impact on the security of our great country. You have superbly executed the wing's mission and your laudable safety record, while training and employing in the E-3, speaks for itself. Due to high operational tempo, I am deeply concerned that your voice has not been represented in several important areas. The questionnaire provides you an opportunity to express your concerns regarding these areas.

I am aware your time is valuable and would hope that you would take just a few minutes to answer the short attached questionnaire. This is a private study funded by myself and there is no requirement by the U. S. Air Force or any other organization for you to participate. However, your professional views are very important to me. With your help, I may be able to better inform the senior leadership on several issues to include the following: the future of the E-3 navigator in the Air Force; cockpit modernization; training; safety; job restructuring; and rated career concerns.

To guarantee your confidentiality you need not write your name on the completed questionnaire. However, if you would like me to share the results of this study with you after its completion please write a return home address on the questionnaire or include your name and email address. If you would like to respond by email my home electronic address is as follows: boomergatr@aol.com. Please complete and return this questionnaire (or answer via email) by August 13, 1999 or as early as possible.

The data obtained from those who fly the E-3 will provide valuable insight for future improvements to the weapon system and better prepare the crews for employment in the next century. For weapon viability, the crews must be properly manned, motivated, trained, and equipped. Indicative of their concern, both the wing and group commander have given their permission for this survey and are interested in the results, your careers, and the future of this weapon system.

Once again, thank you for your time and continued dedication to the Air Force and AWACS mission. Those who will lead AWACS tomorrow must be heard today.

Keith R. Allford, Lt Col, USAF
Commander, 965 AACS

APPENDIX B

AWACS PILOT AND NAVIGATOR

QUESTIONNAIRE

Survey Instrument

1. What is your rank?

2. What is your crew position?

3. How long have you been flying AWACS?

4. Do you have any other aircraft experience?

5. Are you a line or staff officer?

6. What are the opportunities in AWACS for pilots or navigators to advance?

7. What career counseling have you had?

8. Do you get professional and career guidance from senior officers?

9. Are you a mentor for new pilots or navigators? Why or why not?

10. What training have you received in GPS/GINS?

11. Do you feel that the GPS/GINS training you received was adequate?

12. How well do you feel your skills as a pilot or navigator are utilized?

13. Are you planning to stay in the Air Force? Why or why not?

14. Do you enjoy being a U.S. Air Force pilot or navigator? Why or why not?

15. How should AWACS utilize the navigator when GPS/GINS installation is complete?

16. Is upward mobility perceived to be a problem for pilots or navigators in the AWACS? In the Air Force?

17. Do you feel the E-3 will be unsafe to fly without a navigator?

18. What will be the future safety factors for the E-3 with and without a navigator?

APPENDIX C

INSTITUTIONAL REVIEW BOARD

APPROVAL FORM

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD

Date:	April 8, 1999	IRB #:	ED-99-100
Proposal Title:	"THE HISTORY, CURRENT UTILIZATION, AND FUTURE PROSPECTS OF THE UNITED STATES AIR FORCE AIRBORNE WARNING AND CONTROL E-3 NAVIGATOR"		
Principal Investigator(s):	H.C. McClure Keith Allford		
Reviewed and Processed as:	Exempt		

Approval Status Recommended by Reviewer(s): Approved

Signature:

Carol Olson

Carol Olson, Director of University Research Compliance

April 8, 1999
Date

Approvals are valid for one calendar year, after which time a request for continuation must be submitted. Any modification to the research project approved by the IRB must be submitted for approval. Approved projects are subject to monitoring by the IRB. Expedited and exempt projects may be reviewed by the full Institutional Review Board.

APPENDIX D

NOTES

1. A 13B is a numerical designator identifying a previous non-rated (now rated) mission crew member who conducts missions in the E-3. The other positions are Mission Crew Commander (MCC), Senior Director (SD), Air Weapons Officer (AWO), Air Surveillance Officer (ASO), and Electronic Combat Officer (ECO).

2. Air Battle Manager is another name for 13B which is a mission crew member on E-3 AWACS.

3. Combat/Over water suggested that navigators only be kept in the organization when the aircraft went to war or when crossing the ocean, similar to previous C-141 and C-5 utilization characteristics

4. ECO is an Electronic Combat Officer who operates the electronic Passive Detection System on the E-3 and is dedicated to identifying airborne electronic emissions and E-3 self-defense

5. EWO is an Electronic Warfare Officer responsible for electronic protection of the aircraft and jamming hostile emissions on the battlefield or in the air

6. Navigator (E-3) is a U.S. Air Force officer formally trained in the art of navigation. His or her duties consist primarily of operating GPS and GINS equipment, operating weather radar to avoid hazardous weather, conduct air-to-air rendezvous with KC-135 and KC-10 air refueling tankers to on-load five in mid air. The navigator will also place the E-3 in a mission orbit and ensure all navigation systems on the E-3 remain accurate.

7. UPT is Undergraduate Pilot Training.

APPENDIX E

DETAILS OF FINDINGS

Details of Findings

To gain a better understanding of the results of the validation study, it was essential to determine the demography of the respondents. Of those 74% of pilots who responded to the survey, 88% (15) were captains and 12% (2) were majors. To compare the response rate by position, the validation study resulted in a 67% rate by pilots compared to the Chapter IV total of 72% for all pilots surveyed and 87% rate by navigators in the validation study compared to the aforementioned 66% for all navigators surveyed.

The average validation study pilot experience level was 4.8 years for pilots and 4.28 years for navigators compared to 4.47 years for pilots and 3.43 years for navigators in the general population. A total experience rate of 4.19 years for pilots and 3.43 years for navigators indicates a relatively young crew force existed in the 552 Air Control Wing (ACW) during the study. The validation study further revealed that 70% of the pilots were experienced while the navigators were only 43% experienced. The general population was only 66% experienced in the pilot community and 43% experienced in the navigator community. The total percentages revealed 66% of pilots were experienced as compared to only 43% of the navigators.

The validation study experience in other aircraft revealed 29% of pilots had hours logged in the B-52, compared to 19% B-52 and 25% T-37 jet trainer experience in the general pilot population. The total population surveyed revealed 19% B-52, 12% KC/RC/EC-135, and 10% fighter when the T-37 and T-38 jet trainers are excluded. The largest operational aircraft percentage (31%) of experience (excluding trainers) in the pilot general population was the "heavy" aircraft or specifically the B-52 and KC/RC/EC-135

(Boeing 707 type airframe). Also, the validation study revealed most navigators were experienced in the KC/RC/EC-135 or 66%, compared to 27% in the general population or 43% when all "heavies" are included (B-1, B-52, and all –135 series aircraft).

In this study, the respondents also identified whether they were a line or staff officer as mentioned in Chapter IV. The validation study revealed 90% of pilots served in a line capacity compared to 78% in the general population; the navigator was 100% line in the validation study compared to 70% line in the general population.

The data in Table E-II illustrates a comparison of perceptions concerning opportunities to advance in AWACS in the validation study and the same comparison in the general population (excluding 966 AACS validation study), and total population (including 966 AACS validation study).

TABLE E-II

AWACS OPPORTUNITY FOR ADVANCEMENT
VALIDATION STUDY VS. GENERAL
POPULATION PERCEPTION

Crew position	High %	Average %	Low %	Unknown %
Validation Study				
Pilot	50	10	40	0
Navigator	43	14	29	14
General Population				
Pilot	41	19	25	16
Navigator	30	20	40	10
Total Population				
Pilot	43	17	29	0
Navigator	32	19	38	11

Another notable finding illustrated in Table E-II reveals 40% of the 966th AACS pilots in the validation study perceive advancement in AWACS as low compared to only 25% in the general population. Conversely, only 29% of the 966th AACS navigators perceive advancement opportunities to be low in AWACS compared to 40% of the general navigator population.

The validation study revealed 50% of pilots had received counseling of some sort while 71% of the navigators had been counseled. General population pilots revealed that 41% received career counseling while 59% said they did not receive any advice from leadership concerning their careers. The reverse seemed to apply to the general population navigators by revealing 53% did receive counseling while 47% said they did not receive advice from leadership.

Like the previous indication for pilots in the validation study, 50% stated they had received counseling from senior officers while 57% of the navigators in the validation study received senior officer counseling. The pilots were counseled in the general population by senior leadership at a rate of 53%, while navigators were counseled at a slightly higher rate of 60%.

In regards to mentor duties the validation study revealed 60% of pilots considered themselves mentors (most by nature of their duties as instructor pilots), and 86% of the instructor navigators in the same study considered themselves as mentors. The instructor pilots' perception of their accomplishment of mentor duty in the 966th AACS was considerably lower (60%) compared to the general population who answered affirmative 94% to those duties. Total affirmative pilot response to mentor duties was 86%. The validation study navigators also answered *yes* to mentor duties at a rate of 86% compared

general population navigators who answered *yes* to mentor duties at a rate of 80%. Total navigator response was close at 81%, which is only slightly lower than the navigators in the validation study and slightly higher than the navigator general population. This is mainly due to the 10 lieutenant navigators counted in the general population who felt they had very little to contribute at that point in their careers.

TABLE E-III

METHODS VERSUS PERCENTAGE TRAINED

Study Group	Method	Training Accomplished %	
		Pilot	Navigators
Validation Study			
	Difference/conversion	40	43
	Computer Based Training (CBT)	30	29
	Simulator/Hot Bench	40	43
	Aircraft and On-the-job Training (OJT)	60	71
	Self-taught/no formal training	30	29
General Population			
	Difference/Conversion	22	17
	Initial Qualification Training (IQT)/ Mission Qualification Training (MQT)/ CBT	16	33
	Simulator/Hot Bench/Part Task Trainer (PTT)	28	17
	Weapon System Academic Training (WSAT)	28	10
	Aircraft/OJT	44	33
	None/ self-taught	19	17
	Minimum comments	16	17

As can be seen in the data in Table E-III, there is a notable difference in the training percentage of those surveyed from the 966 AACS in the validation study and the general AWACS pilot and navigator population. This indicated that the GINS training received in the 966 AACS for the initial cadre of instructors utilized multiple methods and was non-standard compared to those in the general population. Many stated in the survey that the overall training received was in fact inadequate. Specifically, the validation study revealed pilots believed GINS training received was 60% inadequate compared to validation study navigators that reported a higher 86% inadequate rate. It is essential to note that during the initial GINS conversion, instructor navigators in the 966 AACS were and are still considered key facilitators to ensuring training continuity in GINS throughout the wing for both pilots and navigators. The general pilot population revealed 72% inadequate rate in their GINS training compared to the general navigator population who reported less inadequate training at 57%.

The data in Table E-IV illustrates a comparison of views concerning whether or not their skills as a pilot or navigator were utilized with the new technology being introduced to the E-3 AWACS. Specifically, the percentages from the pilots and navigators in the validation study and those in the general population are reflected in the table below.

TABLE E-IV

PERCENTAGE OF SKILLS UTILIZED IN E-3 AWACS

Study Group	% Good	% Ave	% Poor	% Unknown
Validation Study				
Pilot	40	40	20	0
Navigator	14	43	43	0
General Population				
Pilot	47	22	28	3
Navigator	37	30	27	6

As the data in Table E-IV illustrates, navigators in the validation study thought their skills were utilized poorly at a rate of 43%. However, navigator respondents in the general population thought their skills were utilized poorly at a rate of 27% and thought their skills were challenged at an average rate of 30%.

Retention was the next concern of the survey when it asked respondents to specify their intentions to remain or depart the Air Force. Chapter IV outlines the general overall results of this question for pilots and navigators. As a comparison, the retention possibilities were revealed in the validation study that the percentages of those planning to leave the service were overall higher in the 966 AACS than in the three operational combat flying squadrons (963, 964, and 965 AACS). Specifically, the 966 AACS indicated that 70% of the pilots were planning to leave the Air Force at the end of their

commitment. Not far behind the pilots were the navigators in the 966 AACS at 57% who were planning future careers outside the Air Force.

The operational combat flying squadrons indicated a significant decrease in percentage points when asked the same question. Specifically, 41% of the combat pilots indicated they would leave after their commitment, but only 17% of the navigators planned to terminate their service after their first commitment expired. One possible reason navigator percentages to leave the Air Force were so low was due to the number of lieutenants (10 or 33%) counted in their respondent ranks, which equaled navigator captain subgroup numbers (10), whereas pilots had no lieutenant respondents to drive that percentage down. This less experienced lieutenant subgroup within the navigator group was not historically at the career decision point which, through experience and empirical observation, normally occurs at the four to five year point or approximately around the time most Air Force officers are promoted to captain. Conversely, 18 captains responded on the pilot side, which accounted for 56% of all general population combat pilots, which also accounted for the largest subgroup within the pilot group.

Overall, the 966 AACS had a much higher rate of dissatisfaction with the Air Force but, perplexingly, had the most stable life style in AWACS. Specifically, the 966 AACS instructor pilots in the validation study claimed military benefit erosion was their number one reason for leaving the service at 50%. Secondly, 40% were concerned about family as their next largest complaint in AWACS, but again spent more time home with their families than any other wing pilot. The operational flying squadron pilot and navigator respondents who go TDY at a higher rate and are separated longer from family, were 28% in agreement on concerns about stress on the family due to long periods from

home and were normally deployed from home in excess of 120 days per year. As for benefit erosion, only 6% of the operational pilots and navigators were concerned.

Job satisfaction or job enjoyment was another concern of the study, which sought a response from pilot and navigator participants. The overall total indications for pilots and navigators in AWACS were recorded in Chapter IV. By comparison, pilots and navigators in the validation study from the 966 AACS indicated that they were more displeased with the Air Force for reasons of long family separations. This can probably be understood since the experienced pilot and navigator are typically older, more mature, and thus more family oriented compared to the possibly younger and single entry level operational pilot or navigator. This may explain the increased concern for family in the 966 AACS training squadron. However, age and family status was not asked for in the survey therefore, age and maturity could not be correlated with 966 AACS respondents' family concerns in this study. Basically, the 966 AACS respondents they spent more time at home than any other AWACS squadron pilot or navigator but were the most concerned about family matters.

The survey then led the respondents to indicate whether they actually enjoyed their jobs. The 966 AACS pilots were 50% satisfied and navigators were only 29% satisfied. The 966 AACS navigator indications also revealed that a notable 57% were absolutely not satisfied and 14% were undecided. The operational combat squadrons told an entirely different story. Combat pilots were 91% satisfied and combat navigators were 87% satisfied with their jobs.

The respondents were then asked to specify what should be done with the E-3 navigator once the GINS modification is complete. Chapter IV provides general

indications of overall pilot and navigator views in the 552nd ACW and the expanded and detailed Table E-V below provides specifics as to where the navigator should be employed to take advantage of their unique training.

TABLE E-V

KEEP VERSUS REMOVE E-3 NAVIGATORS AND HOW THEY SHOULD BE UTILIZED

Study Group/ Prevalent Answers	Pilot %	Navigator %
Validation Study		
Keep Navigator	70	43
% Train as ECO/13B*	14	0
% Train as EWO*	14	0
Remove Navigator	20	43
% UPT*	50	67
Unknown	10	14
General Population		
Keep Navigator	69	47
% Train as ECO/13B*	23	57
% Combat/Over Water*	0	7
Remove Navigator	13	43
% Cross Train to Another Aircraft	25	23
% UPT*	25	15
Unknown	17	10

NOTE: See Appendix D for definition of asterisked items; the sub areas under the "keep" or "remove" categories provide percentages that will not necessarily equal 100%. For example, in Table E-V under the general population heading, "Remove Navigator" sub-heading, 13% of the pilots stated "remove the navigator." Of those

13%, 25% of those respondents indicated the navigator should be allowed to cross train to another aircraft, and 25% thought they should go to UPT. The other 50% of the "remove navigator" answers did not specify what should be done with the navigator after removal.

Pilots in the validation study felt that navigators should stay (70%), while 20% thought they should be removed. The navigators were split in the validation study (43% to keep and 43% to remove) and 14% were undecided. The general population pilot was convinced the navigator should stay at 69%, while only 13% thought they should be removed from the E-3. The navigators in the general population were again almost split (47% to keep the navigator and 43% to remove).

The survey respondents were again asked to provide their assessment concerning upward mobility in AWACS and the Air Force in general. Chapter IV addresses the total percentages for all AWACS pilots and navigators. By comparison, the 966 AACS validation study revealed that 100% of the pilots felt that upward mobility was difficult in AWACS and 60% agreed it was also difficult in the Air Force. The navigators felt slightly less hindered at 86% difficulty rate in AWACS and 57% difficulty rate in the Air Force in general. The combat operational squadrons again had different indications. The operational pilots thought upward mobility in AWACS was difficult at a rate of only 47%, but viewed the difficulties in Air Force progression at a rate of 22%. This was much more notable compared to the aforementioned 60% reported for the 966 AACS pilots. The operational navigators were less optimistic and considered AWACS upward mobility to be difficult at a rate of 63% and even more difficult Air Force wide at a rate of 73%. In general, the operational pilots seemed more optimistic about upward mobility opportunities in AWACS and the Air Force than the instructor pilots surveyed in the 966

AACS. Operational navigators seemed less optimistic than pilots in both categories with the most noted change in the Air Force category. Specifically, operational navigator responses differed from pilots by over 50% by stating they were less confident in Air Force upward mobility opportunities.

Specific comparisons between the validation study and the general population concerning the pilot and navigator perceptions of the need for the navigator, confidence level of the pilots without the navigator, and whether safety would be a factor if the navigator were removed revealed some notable results. The validation study revealed that 70% of the pilots felt the E-3 would still be safe without the navigator, which indicated their increased confidence level. Additionally, 57% of the validation study navigators felt the same way. The general population operational pilots felt "slightly less safe" without the navigator at a rate of 63%, while the operational navigators felt E-3 operations without them would be safe at a rate of 53%. Overall, the survey results revealed that validation study pilots felt more confident without a navigator at a rate of 70%. Again, this might be attributed to their experience, while conversely the less experienced pilots in the operational squadrons thought the E-3 was "slightly less safe," thus indicating there was still a need for the navigator until training and experience improved. Also, the pilots' confidence in their training without the navigator was lower than it should have been due to their "slightly less safe" attitude which was again indicated at a percentage of 63%. Finally, general population navigators thought the E-3 was "less safe" without a navigator at a rate of 53%.

The last question of the survey provided an indication as to what pilots and navigators were concerned about, with and without the navigator (See Table E-VI). The

pilots in the validation study were concerned about training in GINS (50%), removal of situational awareness (50%), and removal of experience (30%) as their top three concerns. The navigators in the validation study were focused on crew coordination and loss of backup for the pilots during an emergency, both at 43%, as their top two areas. The navigators had additional concern for increased workload, mission planning, and in-flight re-planning, all at 29%. The general population pilots were concerned about airframe and engines (22%) as their top safety factor concerns if the navigator remained on the E-3, while the navigators had a 30% agreement that there were no safety concerns with a navigator still working on the E-3. Without the navigator the pilots were concerned, as were the navigators in the validation study, with pilot and flight engineer GINS training at 25% and crew resource management (CRM) and experience loss as their top three concerns at 22%. The navigators were concerned with crew resource management at 37%, life and death issues at 33%, and workload increase for the pilots and flight engineers at 27%.

TABLE E-VI

SAFETY FACTORS WITH AND WITHOUT THE E-3 NAVIGATOR

Study Group/factors	Pilot %	Navigator %
Validation Study		
With Navigator		
Experience kept	10	0
Better workload Distribution	10	0
Better Situation Awareness	10	0
Without Navigator		
Training for Pilots	50	14
Training for Flight Engineers	0	14
Remove Situation Awareness	50	14
Loss of Experience	30	14
Crew Coordination Suffers	20	43
Life and Death	20	14
Increased Workload	20	28
Combat Capability of Equipment	10	
Back-up from Navigator/ Emergencies	0	43
In-flight Re-plan Mission	0	29
Mission Planning	0	29
General Population		
With Navigator		
None	6	30
Cockpit Resource Management	0	3
Complacency Due to Equipment	0	7
Experience Kept	6	0
Workload Distribution	9	0
Situation Awareness	6	0

TABLE E-VI (Continued)

Study Group/factors	Pilot %	Navigator %
Backup Pilots	3	0
Airframe/engines	22	7
Unknown	6	0
Without Navigator		
None	3	3
Workload Increase	9	27
Mission Planning	0	10
Equipment Problems	6	17
Situation Awareness	9	13
Cockpit Resource Management	22	37
Emergency Procedures	13	17
Life and Death	6	33
Experience Loss	22	10
Pilot/Flight Engineer Training	25	10
Task Saturation	9	17

Note: 71% of respondents did not address specifically safety factors with the navigator, only without the navigator.

During the survey period two mailings were needed to gain the 79% response rate to ensure an adequate sampling could be made of the population. Table E-VII illustrates a comparison of the responses by pilots and navigators associated with the two mailings.

TABLE E-VII

SIMILARITIES & DIFFERENCES OF RESPONSES BETWEEN MAILING ONE AND MAILING TWO OF THE SURVEY

Question #/position	Group 1 #/%	Group 2 #/%
1. Pilot Respondents (#)		
2Lt	0	0
1Lt	0	0
Capt	8	10
Majors	5	2
Lt Col	4	3
Navigator Respondents (#)		
2 Lt	1	0
1Lt	4	5
Capt	4	6
Major	2	2
Lt Col	5	1
2. Pilot (#)	17	15
Navigator (#)	16	14
3. Pilot (# Years Average)	3	6
Navigator (# Years Average)	3	4
4. Pilot (% Experienced)	71	60
Navigator (% Experienced)	50	35
5. Pilot (% Line)	82	73
Navigator (% Line)	56	86
6. Pilot (%) High	47	33
Average	18	20
Low	23	27
Unknown	12	20
Navigator (%) High	44	14
Average	6	36
Low	44	36

TABLE E-VII – Continued

Question #/position	Group 1 #/%	Group 2 #/%
Unknown	6	14
7. Pilot (%) Yes	47	33
No	53	67
Navigator		
(%) Yes	56	50
No	44	50
8. Pilot (%) Yes	59	47
No	41	53
Navigator		
(%) Yes	56	64
No	44	36
9. Pilot (%) Yes	100	87
No	0	7
Unknown	0	7
9. Navigator (Cont)		
(%) Yes	75	86
No	19	7
Unknown	6	7
10. Pilot/Navigator (%)		
Difference/Conversion	24/19	13/14
Hot Bench/Simulator	41/25	13/7
IQT/MQT/CBT	12/38	20/29
WSAT	29/6	27/14
Aircraft /OJT	53/31	33/36
None/Self-Taught	18/25	20/7
Minimum/Inadequate	29/19	7/14
Needed Formal School	6/6	7/0
11. Pilot/Navigator (%)		
Adequate	24/44	33/43
Not Adequate	76/56	67/57

TABLE E-VII – Continued

Question #/position	Group 1 #/%	Group 2 #/%
12. Pilot/Navigator (%)		
Good	47/38	47/36
Average	34/31	20/29
Poor	24/25	33/29
Unknown	6/6	0/7
13. Pilot/Navigator (%)		
Yes	24/63	47/64
No	41/25	40/7
Unknown	29/13	13/29
Reserves	9/0	7/0
14. Pilot/Navigator (%)		
Satisfied	82/81	100/93
Not Satisfied	18/19	0/7
15. Pilot/Navigator (%)		
Keep Navigator	65/50	73/43
Remove Navigator	6/50	20/36
Unknown	24/6	7/21
Cross-Train	6/6	0/14
Train as ECO	18/25	13/29
Combat/Over Water	0/6	0/0
UPT	0/6	7/7
16. Pilot/Navigator (%)		
AWACS		
Difficult	35/75	60/50
Not Difficult	47/25	27/43
Unknown	18/0	13/7
Air Force		
Difficult	24/88	20/57
Not Difficult	59/0	40/36
Unknown	18/13	40/7
17. Pilot/Navigator (%)		
Safe	59/50	67/57

TABLE E-VII – Continued

Question #/position	Group 1 #/%	Group 2 #/%
Unsafe	35/50	27/43
Unknown	6/0	7/0
18. Pilot/Navigator (%)		
With Navigator		
Airframe/Engines	24/13	20/0
No safety factors	0/44	13/14
Experience drop	0/0	13/0
Situation Awareness	0/0	13/14
Backup pilots	0/0	7/7
Workload	0/0	20/0
Without Navigator		
Workload Increase	12/19	7/33
Equipment Malfunction	12/19	0/14
Situation Awareness	6/13	13/14
CRM Suffers	35/31	7/43
Emergency Procedures	18/6	7/29
Life and Death	6/13	7/57
Crew Experience Decline	41/13	0/7
Pilot/FE Training	24/0	27/14
Pilot Task Saturation	18/13	0/21
Mission Planning	0/13	0/7
None	0/0	7/7

Note: See Appendix D for question alignment with associated # above.

APPENDIX F

GLOSSARY OF TERMS

Glossary of Terms

AWACS – Airborne Warning and Control System: This system is an airborne radar platform to facilitate radar coverage of other airborne targets (airplanes or missiles) deeper into an adversary's territory than a ground radar site was capable of, due to the curvature of the earth. Specifically, a ground radar site could only cover approximately 60 miles whereas the AWACS could cover over 200 miles into an area of interest. The AWACS acronym is also synonymous with another commonly used acronym, which is the E-3 (AWACS Introductory Training Manuals, 1982).

E-3 – An E-3 is an alpha-numeric designator used in the United States Air Force (USAF) to denote a Boeing 707 four engine jet aircraft converted from an airliner to carry the radar dish positioned on top of struts attached to the aft fuselage. Some associate the radar dish with a "Frisbee" looking device (Technical Order 1E-3A-1, 1999).

E-3 Aircrew - Each E-3 carries a crew of approximately 23 people. The following are a breakdown of these positions: pilots (2), navigator (1), flight engineer (1), Communications Systems Operator (CSO) (1), Communications Technician (CT) (1), Computer Display Maintenance Technician (CDMT) (1), Weapons Controllers (WD) and Air Weapons Officers (6-7), Mission Crew Commander (MCC) (1), Senior Director (SD) (1), Air Surveillance Officer (ASO) (1), Electronic Warfare Officer (ECO) (1), Senior Surveillance Technician (SST) (1), Air Surveillance Technician (AST) (3), and the Airborne Radar Technician (ART) (1). All are enlisted except the pilots, navigator, MCC, SD, AWOs, and the ASO (AWACS Introductory Training Manuals, 1982).

13B – a "13 Bravo" is any officer mission crewmember on the E-3 (MCC, SD, AWO, ECO, or ASO). The 13B is also designated as Air Battle Manager. (See also Appendix D)

GINS – GPS Integrated Navigation System: This system consists of two GPS receiver antennas, two ring-laser [INS] gyros, two air data computers (ADC), two data buses (Technical Order 1E-3A-1, 1999)

GPS – Global Positioning System is a system consisting of 24 satellites positioned in space so that the user, whether they be in the air or on the ground can determine their location using three to four signals from those satellites (Bowdich, 1984).

INS – Inertial Navigation System internal and self-contained navigation system which uses the accelerometer, the gyroscope, and the electronic computer (Bowdich, 1984).

Navigator – A person trained and skilled in the art of navigation (Bowdich, 1984)

Observer – This was another name for navigator (Army Air Corps, 1927).

OMEGA – Twelve ground based emitters positioned around the world to provide navigation signals to aircraft with receiver sets which triangulates the aircraft's position (Bowdich, 1984).

Rated Officer – A rated officer, or "flying officer or observer," was any Air Force pilot or navigator who graduated from Undergraduate Pilot or Navigator Training and thus awarded the aeronautical rating of pilot, navigator, or aircraft observer (National Defense Act of 1920, 1921). This was the only type of rated officers until October 1, 1999 when the 13B crewmember was also rated by law (AWACS Archives, 1999).

VITA

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Candidate for the Degree of

Doctor of Education

Thesis: PERCEPTIONS OF PILOTS AND NAVIGATORS CONCERNING THE FUTURE PROSPECTS OF THE UNITED STATES AIR FORCE AIRBORNE WARNING AND CONTROL E-3 NAVIGATOR

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Experience: Entered the U.S. Air Force enlisted in 1973. From 1973 to 1977 worked as an Inventory Management Specialist in the 381st Civil Engineering Squadron. Cross-trained into the In-flight Refueling Operator career field in 1977 and flew the KC-135 as a Boom Operator. Went to Officer Training School in October 1981 and graduated a Second Lieutenant in January 1982. Attended and graduated from Navigator training in October 1982. Moved to the E-3 (AWACS) in October 1982. Upgraded to instructor navigator in July 1984. Moved to the 966 AWACS training squadron in July 1984 to train new navigators in the E-3. In October 1985 moved to Okinawa, Japan. Upgraded to evaluator navigator in June 1986. In November, 1988, moved to Tinker Air Force Base (AFB),

Oklahoma and again the E-3 AWACS. In March 1989 became one of three evaluators in the 552nd AWACS Wing. Became the initial test navigator for GPS incorporation into the E-3 AWACS. Conducted test flights with Boeing Seattle to accept the initial modified 30/35 E-3 at Tinker AFB. In July 1990 moved to 28th Air Division Tactics and became Chief of Flight Tactics. In August 1990 deployed to Saudi Arabia in response to Iraq attack on Kuwait. Developed a portion of AWACS Desert Storm war plan, a member of the "Black Hole" planning cell. Moved to 966th AWACS training squadron again in July 1991 to assume duties as Flight Commander, responsible for training navigators and flight engineers in AWACS. Moved to Langley AFB, Virgina as a staff officer on the Air Combat Command Staff. Worked as Chief of South American and Pacific Exercises and Deployments. Returned to Tinker AFB in June 1996 to lead the 963rd Airborne Air Control Squadron (AACS) in flight crew training for GINS 30/35 modification, largest in Air Force history. Moved to 964th AACS in May 1997 as Assistant Operations Officer responsible for the training and execution of the squadron's mission. In August 1998 was appointed Director of Operations of the 966 AACS, supervising flight and training activities for over 150 instructors in 16 different crew positions and over 1000 students per year. In June 1999 to present, took command of the 965 AACS, responsible for the combat mission execution and supervision of over 355 aircrew and ground support personnel flying the E-3 AWACS. First navigator AWACS operational combat squadron commander.

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