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Voluntary and Confidential Reporting Systems as a Means of Reducing the Accident Rate in Shadow 200 Flight Operations

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VOLUNTARY AND CONFIDENTIAL REPORTING SYSTEMS AS
A MEANS OF REDUCING THE ACCIDENT RATE
IN SHADOW 200 FLIGHT OPERATIONS

by

William Lawrence Jagnow

A Thesis Submitted to the Department of Applied Aviation Sciences
in Partial Fulfillment of the Requirements for the Degree of
Master of Science in Aeronautics

Embry-Riddle Aeronautical University
Daytona Beach, Florida
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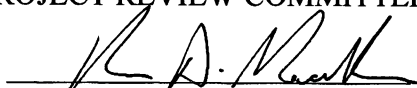
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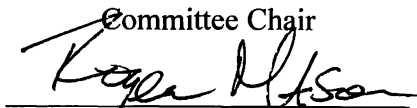
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This Thesis was prepared under the direction of the candidate's Thesis Committee Chair, Dr. Nickolas D. Macchiarella, Assistant Professor, Daytona Beach Campus, and the Thesis Committee Members, Captain Roger Mason, American Airlines, Adjunct Professor, Daytona Beach Campus, and Dr. Thomas R. Weitzel, Associate Professor, Daytona Beach Campus, and has been approved by the Thesis Committee. It was submitted to the Department of Applied Aviation Sciences in partial fulfillment of the requirements for the Degree of Master of Science in Aeronautics.

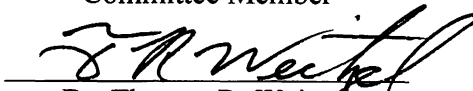
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I would like to thank the Soldiers who participated in my research, as well as their leaders who allowed me to do so. Unfortunately, the importance of maintaining their anonymity does not allow me to name them or the units with which they served. Despite that, you know who you are, and you have my gratitude.

Thanks to my friends and colleagues for their support. In some cases, I have suckered you into reading this manuscript. Abandon all hope, ye who read this; because this part right here is about as exciting as the paper is going to get. I hope you like pie charts and \$10 words.

Now that I have thanked everyone who has been helpful, I would like to thank Starbuck, my Australian Cattle Dog. Wise men have stated that “destruction breeds creation,” and if I have provided the creation, you have provided the destruction. Biting through the power cable to my hard drive proves that “the dog ate my homework” is no myth. Bad dog!

ABSTRACT

Researcher: William Lawrence Jagnow

Title: Voluntary and Confidential Reporting Systems as a Means of Reducing the Accident Rate in Shadow 200 Flight Operations

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Although effective, the United States Army's Shadow 200 Unmanned Aerial Vehicle has suffered an unacceptably high accident rate. Errors committed by operators have significantly contributed to this accident rate. The voluntary and confidential Aviation Safety Reporting System and Aviation Safety Action Program have been successful in identifying and addressing errors committed by air carrier pilots. This study has explored the implementation of voluntary and confidential reporting systems in Shadow 200 flight operations. Mixed methods research combined quantitative survey data and qualitative interview data as a means of determining attitudes relevant to the implementation of such systems. Identified deficiencies included: (a) Checklist errors, (b) misunderstanding of the Operational Hazard Report, (c) reported errors resulting in negative responses, and (d) Shadow operator perceptions of existing error reporting systems. Recommendations have been made relevant to remedying these deficiencies, improving the safety culture in the Shadow community, and conducting further research on related topics.

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LIST OF ACRONYMS

A	Agree
AAI	Aircraft Armaments, Incorporated
AC	Advisory Circular
APA	Allied Pilots Association
ASAP	Aviation Safety Action Program
ASRS	Aviation Safety Reporting System
ATC	Air Traffic Control
AVO	Air Vehicle Operator
CC	Crew Chief
CFR	Code of Federal Regulations
CPL	Corporal
CRC	United States Army Combat Readiness Center
D	Disagree
DOD	Department of Defense
ERC	Event Review Committee
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FAS	Federation of American Scientists
FY	Fiscal Year
GAIN	Global Aviation Information Network

GAO	Government Accountability Office
GCS	Ground Control Station
IP	Instructor Pilot
MC	Mission Commander
MOU	Memorandum of Understanding
MPO	Mission Payload Operator
MSG	Master Sergeant
N	Neither Agree nor Disagree
NASA	National Aeronautics and Space Administration
NCO	Non-commissioned Officer
OHR	Operational Hazard Report
OSD	Office of the Secretary of Defense
PFC	Private First Class
PVT	Private
RL	Readiness Level
RL1	Readiness Level One
RL2	Readiness Level Two
RL3	Readiness Level Three
RSTA	Reconnaissance, Surveillance, and Target Acquisition
SA	Strongly Agree
SD	Strongly Disagree
SFC	Sergeant First Class
SGT	Sergeant

SP	Standardization Pilot
SPC	Specialist
SPSS	Statistical Package for the Social Sciences
SSG	Staff Sergeant
TUAV	Tactical Unmanned Aerial Vehicle
UAV	Unmanned Aerial Vehicle
UEL	UAV Engines, Limited
UPS	United Parcel Service
WO1	Warrant Officer 1

Chapter I

INTRODUCTION

This study has represented an application of concepts from civil aviation in a military setting. As such, the extensive use of military terminology has been unavoidable. Certain words have been capitalized that have not been capitalized in non-military writing (e.g., Soldier, Aviation). This also has been due to military convention.

Unmanned Aerial Vehicles and Accident Rate Reduction

Military operations always have been inherently risky. Nevertheless, the elimination of avoidable accidents has been important to the United States (U.S.) Army. Accidents in military operations have been costly in terms of dollars, equipment, and personnel. This situation has impacted the ability of the U.S. Army to perform its mission. The U.S. Army Combat Readiness Center (CRC), formerly known as the Safety Center, has been charged with collecting, analyzing, and acting upon safety-related data. According to the CRC, “each life saved, each serious injury avoided, and each piece of equipment undamaged may be the deciding factor in a battle in the Global War on Terrorism” (U.S. Army, 2006a, p. 5).

Given the risky nature of military operations, one of the great advantages of Unmanned Aerial Vehicles (UAVs) has been the fact that they are by definition unmanned. Due to the increased frankness with which the media has depicted war, casualties have not been as easily accepted by the public as they were in past wars. The U.S. Army has become less accepting of casualties as well due to increased

socioeconomic pressures such as the cost of training Soldiers. Having studied the changing attitudes in American culture toward casualties in the 20th Century, Eikenberry (1996) noted that:

In the language of an economist, America had a comparative advantage in capital, and was at a comparative disadvantage in labor. With equipment and technology relatively cheap and manpower dear, both economically and politically, it followed that personnel losses would come to be considered as increasingly expensive. America's political leaders variously captured and lost the prize because of their policies during the Korean and Vietnam wars. As casualties mounted in both contests, the electorate increasingly asked what vital interests were at stake to justify the human and economic sacrifice. Both wars led to the defeat of incumbent political parties. The lesson learned for all was that it was politically risky, if not suicidal, to preside over any limited conflict that could not be won quickly, with relatively few casualties. The successes of our military in combat actions in the 1980s and 1990s were no doubt a reaction to Korea and Vietnam, as civilian leaders resolved to use armed force only when we could achieve victory with little loss of life. Yet the extraordinary results may have created strong, and quite possibly unrealistic, expectations among the general public and civilian leaders that armed conflict, properly managed, can usually be waged with little loss of life. (p. 111)

In addition to the loss of human life and degraded unit morale incurred when any Soldier has been killed, each pilot has represented a considerable monetary investment for the U.S. Army. Pilot training has been expensive; the initial training of an Army helicopter pilot has cost an average of \$225,000 (Colucci, 2002). UAVs have circumvented the complications inherent in putting a pilot in danger by physically removing the pilot from the aircraft.

Despite the absence of a pilot in the aircraft, the loss of a UAV has not been without impact. A destroyed UAV could not be used to fly a mission. The RQ-7A Shadow 200 has become the Army's most prevalent UAV. The loss of Shadow 200 UAVs has had a definite impact on the effectiveness of the platoons operating them.

A Shadow platoon missing one or more of its aircraft had to work harder in order to keep its remaining UAVs in a mission ready condition. Shorthanded platoons had to expedite procedures such as between-flight turnaround inspections in order to ensure that a UAV could be on station when it was required. Overall, a Shadow platoon missing an aircraft has felt an increased workload that has been very acute when multiple UAVs have been lost. The loss of a single Shadow UAV in a platoon of four aircraft has dropped the platoon's mission capable rate to, at best, 75%; this has been worse than the comparable OH-58D Kiowa Warrior observation helicopter's historical mission capable rate of 80% (Geary, 2006) or the mission capable rate of 85% promised to the U.S. Army by the Shadow's manufacturer, per the U.S. Government Accountability Office (GAO; 2005).

In addition to the impact on mission readiness, the replacement cost of lost UAVs has been significant. Individual Shadow UAVs have been comparatively inexpensive. A single Shadow UAV had an objective cost of \$452,000 (GAO, 2000), while the OH-58D Kiowa Warrior helicopter, which has performed similar missions, has cost nearly \$30 million dollars (Federation of American Scientists [FAS], 2000). However, the replacement of lost Shadows has been expensive. The Army signed an \$11.4 million contract in September 2006 with Aircraft Armaments, Inc. (AAI), the Shadow's manufacturer, for partial replacement of aircraft lost in the Global War on Terror (Defense Industry Daily, 2006). Therefore, although they have been relatively inexpensive individually, the loss of multiple Shadow UAVs has become expensive.

Unmanned Aerial Vehicles have been very prone to accidents. As of 2001, UAVs had an accident rate up to 100 times that of conventional manned aircraft (Department of

Defense [DOD], 2005). The CRC defines Class B accidents as between \$200,000 and \$1,000,000 in recordable property damage, and Class C accidents as between \$20,000 and \$200,000 of the same. The Shadow 200 UAV had 59 Class B and C accidents in fiscal year 2006 (CRC, 2006). These figures were out of a total fleet of approximately 190 (Kappenman, 2006). As of 2005, the Shadow 200 had posted a Class B accident rate of approximately 190 per 100,000 flight hours (DOD, 2005). These figures compared poorly to an accident rate of 5 per 100,000 flight hours for Army rotary-winged aircraft (CRC, 2006). The Project Manager for Army Unmanned Aircraft Systems has called for a 50% reduction in the UAV accident rate every year for the next four years (Hazelwood, 2006). Figure 1 has depicted the Shadow 200.



Figure 1. The Shadow 200 UAV.

The Shadow 200 UAV

The Shadow 200 has become the Army's most prevalent UAV. The Shadow 200 was selected in 1999 to be the Army's Class IV Unmanned Aerial Vehicle. This Class designation gave the Shadow the task of supporting maneuver brigades, the Army's primary combined arms combat unit. In effect, the Shadow has been designated to perform missions requiring more capabilities than the smallest UAVs (e.g., the RQ-11 Raven) but requiring more flexibility than the largest (e.g., the RQ-1 Predator).

Description

With an objective cost of \$452,000 per aircraft, the Shadow was designed and manufactured by AAI, based in Hunt Valley, Maryland (GAO, 2000). The RQ-7A has been the original production model of the Shadow 200, and the RQ-7B has been a slightly upgraded version with better performance to include endurance and loiter speed.

The Shadow 200 has performed the Reconnaissance, Surveillance, and Target Acquisition (RSTA) mission for the U.S. Army. In practical terms, this has included such missions as (a) enemy observation and reporting of size, disposition, and movement, (b) target detection and acquisition, (c) identification of key terrain such as avenues of approach, and (d) Bomb or Battle Damage Assessment (U.S. Army, 2006b). Army Aerial RSTA has been performed by a multitude of aircraft in a primary or supplementary capacity. Primary manned RSTA aircraft included the OH-58D Kiowa Warrior and the OH-6 Little Bird. Table 1 has provided a brief description of the salient features of the RQ-7A and RQ-7B variants of the Shadow 200.

Table 1

Salient Features of Shadow 200 UAV (Adapted from DOD, 2005)

	RQ-7A	RQ-7B
Length	11.2 feet	11.2 feet
Gross Weight	327 lb	375 lb
Fuel Capacity	51 lb	73 lb
Engine Make	UEL AR-741	
Endurance	5 hours	7 hours
Ceiling	14,000 feet	15,000 feet
Sensor	Electro-Optical (TV), Infrared (IR)	
Wing Span	12.8 feet	14 feet
Payload Capacity	60 lbs	60lbs
Fuel Type	MOGAS	
Power	38 hp	38 hp
Max/Loiter Speeds	110/70 kts	105/60 kts
Datalink Radius	68 nm	68 nm
Takeoff/Landing	Catapult / Arresting Wire	

Advantages

The Shadow 200 has enjoyed several advantages in the RSTA role over traditional manned aircraft. Although exact figures are not available, the Shadow 200 has performed the same missions as manned reconnaissance aircraft at drastically reduced costs. A complete Shadow system, including four UAVs and all the associated ground equipment, has cost approximately \$10 million (Swibel, 2006). By comparison, the OH-58D had a replacement cost of nearly \$30 million (FAS, 2000). The Shadow has required less fuel, less maintenance, and a smaller logistical chain. As a result of the cost and logistical advantages, the Shadow has been able to remain over a target (providing 24-

hour observation) with less degradation of pilot and machine than comparable helicopters (N. D. Macchiarella, personal communication, May 26, 2007). The most obvious advantage of the Shadow, however, has been the absence of a pilot in the aircraft. The Shadow 200 has been able to operate in areas with an enemy air defense threat without fear of an American Soldier being placed in harm's way. Finally, it has been possible for entire Shadow system to be deployed using three C-130 transport aircraft. These advantages have made the Shadow an attractive choice as a reconnaissance aircraft.

Combat Record

The Shadow 200 has enjoyed considerable success in service with the U.S. Army. Shadow systems have deployed to Iraq and Afghanistan in support of a myriad of Army combat units, to include Special Operations Forces. Shadows had flown over 17,000 sorties and upwards of 76,000 flight hours in combat by May 2006 (Spacewar, 2006). Shadow platoons from every Active Army division had deployed to Iraq as of March, 2007, as well as platoons from National Guard divisions and separate brigades. Notably, Shadow platoons were involved in several high-profile operations conducted by the Joint Special Operations Command. *Army Times* credited Shadow 200 participation in the pursuit of Abu Musab al-Zarqawi, the head of Al-Qaeda in Iraq (Naylor, 2006). Satisfied with the performance of the Shadow 200, the Army had ordered 73 Shadow systems as of November, 2006 ("Shadow 200," 2006).

Problems

As capable as the Shadow 200 has been, it has demonstrated many limitations. Power and propulsion failures, problems with the datalink between the UAV and the Ground Control Station (GCS), and human factors issues to include excessively high

occurrences of operator error have contributed to a high accident rate (CRC, 2006). The Army has been aggressively pursuing solutions to these problems.

Power and Propulsion

Throughout its lifetime, the Shadow has been plagued by power and propulsion problems. Table 2 has provided a breakdown of Shadow engine failures in Fiscal Years (FYs) 2004, 2005, and 2006.

Table 2

Breakdown of Shadow Engine Failures (Adapted from CRC statistics, 2006)

	RQ-7A	RQ-7B	Total
FY 2004	12	0	12
FY 2005	16	14	30
FY 2006	3	24	27
FY 2007	0	3	3
Total	31	41	72

It is important to note that the makeup of the Shadow fleet has had an impact on the numbers of engine failures each year. In FY 2004, the Shadow fleet was not close to its planned size; this situation resulted in higher usage rates and increased engine wear. Additionally, few if any RQ-7B models were fielded. The fleet size reached maturity in FY 2005. As FY 2006 came to pass, the majority of the fleet shifted to RQ-7B models. The FY 2007 numbers are as of November 15, 2006, and therefore have not reflected a complete year, as have the other figures. Nevertheless, the numbers above have represented a severe problem with the Shadow's AR-741 rotary engine, manufactured by British firm UAV Engines Limited (UEL).

Datalink

Problems have also existed with the link between the UAV and the GCS. Datalink failure during control station-to-station transfer resulted in the loss of two Shadows in a single mission. The first air vehicle was damaged due to a failure of the Tactical Automated Landing System, responsible for autonomously directing the Shadow on final approach for recovery. Following procedure, the operators issued a command to kill the engine of the stricken UAV. The command, however, was not accepted by the GCS's malfunctioning transmitting antenna. The same crew and GCS were then tasked to accept a second Shadow for recovery. Upon taking control of the second Shadow, however, the command to kill the engine was finally sent—resulting in the crash of the second air vehicle (Williams, 2004). Several other Shadows have been lost due to uplink-related issues as well.

Human Factors

Human factors-related issues have resulted in the loss of several Shadows. A report by the U.S. Army Aeromedical Research Laboratory stated that “human error plays a major role in U.S. Army UAV accidents” (Manning, Rash, LeDuc, Noback, & McKeon, 2004, p. 20). The report noted that 32% of Army UAV accidents between FY 1995 and FY 2003 were attributed to human factors issues. Significantly, the report identified “. . . individual unsafe acts or failures as the most common human-related causal factor category, present in approximately 61% of the 18 human error related accidents” (Manning et al., 2004, p. 20). A detailed analysis specifically of Shadow accidents revealed that procedural errors occurred in 40% of the accidents studied

(Williams, 2004). Clearly, operator error cannot be ignored as a major contributor to the loss of Shadow UAVs.

Statement of the Problem

Although the Shadow 200 UAV has greatly enhanced U.S. Army combat operations by providing RSTA missions at lower cost and lower risk to Soldiers, the loss of Shadow 200 airframes has eroded the effectiveness of the system and, in turn, the effectiveness of the Shadow Platoon. These losses have made it more difficult for maintenance crews to keep the aircraft mission ready at best, and have rendered the Shadow platoon combat ineffective at worst. Losses also have decreased the system's cost effectiveness, as evidenced by the massive cost of procuring replacement airframes. In addition, the real possibility of a UAV accident severely injuring or killing a person has existed.

Purpose of the Study

Reducing the accident rate can positively impact the combat effectiveness and cost effectiveness of the Shadow UAV. The identification of errors committed by Shadow operators could assist in reducing the accident rate. There has been no research performed on using voluntary, confidential reporting systems, such as those employed in civil air carrier operations, as a means of identifying UAV operator errors. This study has examined how such reporting systems could best be implemented in Shadow UAV flight operations.

Delimitations

This study has focused on the Shadow 200 UAV. Although there were many other UAVs serving with the DOD, let alone the U.S. Army, only Shadow 200 flight operations

were studied so as to limit the scope of the study. (The researcher's personal experience was limited to Shadow operations.) Similarly, only Shadow operators were studied. Although maintainers and platoon leadership have also made errors resulting in accidents and incidents involving the Shadow, they were omitted from the study so as to reduce complexity.

Likewise, only the principles of two individual-oriented reporting programs (Aviation Safety Action Program [ASAP] and Aviation Safety Reporting System [ASRS]) were discussed, explored, and used as models. Although there were other voluntary, confidential reporting systems, such as the Voluntary Disclosure Reporting Program, only those two reporting systems that have focused on reports by individuals were considered. This decision was made to reduce the complexity of the study. The implementation of voluntary and confidential self-reporting systems in Shadow flight operations was described in as much detail as the study permitted. Many of the details of implementation, both logistical and regulatory, were omitted so as to limit the length and depth of the study.

Details about the participants that could be used to identify individuals (e.g., unit names and locations) were omitted to the greatest extent possible so as to protect the identities of the participants. Confidentiality was determined by the researcher to be a key factor in ensuring candid responses by the participants, given the potentially sensitive nature of some of the responses. The researcher felt that protecting the participants and justifying their faith in the utter confidentiality of the study took precedence over complete transparency of the methods. Similarly, the exact phrasing of interview

responses, as well as details used in the responses to include dates and locations, were in some cases de-identified by the researcher.

By chance alone, all participants in the study were male. As such, the researcher made the decision to use the male “he” in all cases to describe the participants. This has been a matter of convenience and clarity only, and does not represent any bias on the part of the researcher.

Chapter II

REVIEW OF RELEVANT LITERATURE

The DOD recognized the importance of improving safety and reliability in flight operations for all Unmanned Aircraft Systems. A great deal of effort has been exerted in two principal areas of concern. These areas of concern have been: (a) eliminating equipment deficiencies that cause accidents and (b) rectifying human factors issues that cause accidents.

The Army has identified several aspects of the Shadow 200 that must be improved in order to increase safety and reliability. Some of these aspects were highlighted in a 2003 study by the Office of the Secretary of Defense (OSD), which identified key failure areas for the Shadow 200: power and propulsion, communications, and ground accidents (Schaefer, 2003).

The OSD study had a wide range of suggested fixes for these problems. Remedies such as the substitution of lighter engine blocks, “heavy fuel” engines, or fuel-cell powered engines were suggested to resolve the power and propulsion issues. The use of electronically-steered array antennas in place of conventional, mechanically-steered antennas as well as solid-state amplifiers was recommended to solve datalink reliability issues. Ground reliability issues had no clear cut solutions (Schaefer, 2003).

Mechanical changes to the Shadow 200 have been implemented or designed to reduce the likelihood of certain types of mechanical failures. Athena Controls, Inc. has designed and manufactured a new flight control system for the Shadow, the GuideStar

211e. The newer RQ-7B variant of the Shadow features the UEL AR741-1100 series engine, which has been developed to replace the unreliable AR741 engine used on the RQ-7A (Parsch, 2006). Although the new flight control system has improved the reliability of the Shadow, the engine still has shortcomings, as highlighted by the engine failure accident statistics in Table 2.

Analysis of human factors issues identified several problems but few solutions. One problem identified was the UAV operator's deprivation of sensory input from the air vehicle he is flying. Auditory cues were suggested as a possible remedy, but the tendency of these cues to increase the cognitive demands on the pilot offset any possible benefit (McCarley & Wickens, 2004). Augmented reality has been described as "a machine vision and computer graphics technology that spatially registers graphics over features in the observed world" (Majoros & Jackson, 2005, p. 2).

McCarley and Wickens (2004) suggested augmented reality as a remedy, with benefits in accuracy and a reduction in cognitive demands. McCarley and Wickens also recommended a redesign of displays and a renewed focus on crew resource management training to resolve issues in crew workload demands.

Aviation Branch Proponency

The Shadow was formerly overseen by the Army's Military Intelligence branch. This presented many cultural challenges in supporting what was in many respects an aviation system. Recognizing this difficulty, the Army transferred proponency for all UAVs, to include the Shadow, to its Aviation branch. The Aviation branch has recognized many of the problems causing the Shadow's high accident rate, and has developed means to remedy these problems.

The Aviation branch has determined that a lack of cultural aspects common in manned aviation has contributed to the Shadow's high accident rate. Two factors targeted for improvement are the lack of mentorship for Shadow operators, maintainers, and unit leaders; and the lack of *Aviation rigor* (good practices, seen as basic or fundamental in Aviation) in Shadow training, maintenance, and operations (Buford, 2006).

Moving Shadow platoons out of multi-purpose "Special Troops Battalions" and into Aviation brigades has been seen as an important step forward by leaders in the Aviation branch towards increasing safety in Shadow operations. Leadership in the Aviation branch has repeatedly emphasized the importance of instilling and emphasizing Aviation rigor or Aviation standards into the Shadow community. Terms such as discipline and culture have also been used to describe favorable aspects of the Aviation branch that must find their way into the Shadow community. Discipline while using the checklist or maintaining an accurate toolbox inventory were mentioned as practical means of implementing this culture (Buford, 2006).

Solutions were also suggested by the Aviation branch not related to changing the culture in the Shadow community. Revision of the checklist so as to correct human factors shortcomings was suggested as a means of improving safety. An increased emphasis on crew coordination during training was also mentioned. Sending UAV warrant officers (i.e., technicians responsible for UAV operations) to the Army's Aviation Safety Course was also recommended (Hazelwood, 2006).

Existing Solutions

Materials solutions to the loss rate for Shadow UAVs have been many. However, these solutions have been most effective in solving the mechanical or physical problems,

and are of dubious use in reducing losses due to operator error or other human factors shortcomings. The Army has expressed an interest in reducing operator error, but has focused on sweeping changes in the culture of the UAV community. Although culture has been important, there has been no substitute for addressing the specific operator errors that have caused the losses of Shadows attributed to human factors. Voluntary and confidential reporting systems have been readily accepted as effective in identifying and helping to rectify such errors in air carrier operations.

Voluntary and Confidential Reporting Systems

The Federal Aviation Administration (FAA) has developed several programs for gathering anecdotal data on flight operations and/or correcting observed deficiencies. Among these programs, two have focused on reports from individual operators. These programs are the Aviation Safety Reporting System (ASRS) and the Aviation Safety Action Program (ASAP).

Aviation Safety Reporting System

The Aviation Safety Reporting System was first instituted by the National Aeronautics and Space Administration (NASA) in 1976. ASRS has allowed for voluntary, anonymous self-disclosure of errors committed while flying. The ASRS allowed NASA to gather a vast wealth of data about the state of airline safety. Per a memorandum signed by FAA and NASA administrators, ASRS has existed to “provide information to the FAA and the aviation community to assist them in reaching the goal of identifying and eliminating unsafe conditions to prevent accidents” (Connell, 2006, p. 4).

ASRS reports have initially required a name and contact information for the submitter. However, the submitter has only been contacted to clarify information in their

report. Once this requirement has been met, the report has become totally anonymous. Submission of an ASRS report has also allowed the submitter immunity from FAA enforcement action for that incident, provided that certain criteria have been met. This privilege could only be exercised once every 5 years, although there has been no limit to how many ASRS reports could be made (Connell, 2006).

ASRS data have been used for a variety of purposes. One use has been the creation of a searchable database. This database has been used to determine safety trends and causes for concerns by the FAA, as well as other purposes such as academic research. ASRS alerts have been issued in response to certain threats. These alerts have had an effect, as NASA has determined that 49% of recipients have taken action in response to them. The highest historical volume of report intake was recorded in 2005, with 40,657 reports submitted (Connell, 2006). One of the greatest strengths of ASRS has been the system-wide perspective.

The restrictions in confidentiality and use of the data that made ASRS possible has also limited the amount of action possible based on the data implications. Although a centralized wealth of reports with a system-wide perspective has been created, the ability to respond to individual errors has been nonexistent. Nevertheless, the ASRS has resulted in an enormous wealth of data concerning errors committed by pilots.

Aviation Safety Action Program

The Aviation Safety Action Program was developed in response to the weaknesses of ASRS: the inability to respond to specific errors, and the centralized architecture. ASAP has established a level of confidentiality similar to the ASRS. (In fact, most ASAP reports have also been converted and submitted to ASRS.) Unlike

ASRS, the ASAP reports have been submitted to an Event Review Committee (ERC). This committee has enjoyed considerable latitude in their handling of the report. If the committee found that it did not meet the criteria for submission, they have been able to forward it to the FAA for administrative action. The ERC has also been able to contact the submitter for further information or counseling. Additionally, the findings of many submissions have resulted in fleet-wide publications to resolve a developing problem.

The ASAP has used voluntarily submitted reports of aviation safety hazards to prevent future accidents. In exchange for reporting these risks, employees have been granted limited immunity from punitive actions, provided that their reports met criteria for submission. Reports have been used to identify risks and develop corrective actions for the reported risks. These corrective actions have ranged from individual counseling to company-wide publications. ASAP has also contributed to larger-scale actions to increase air carrier safety. Data from ASAP reports has been gathered into databases for analysis and/or combination with data from other voluntary, proactive safety programs.

Basic Structure of an ASAP

ASAPs have been created with Memorandums of Understanding (MOUs). The MOU has existed between three parties: the airline, the employee group, and the FAA. The ERC has employed a team approach in handling all submissions. Consensus has been required in any decisions made by the ERC (Kelley, 2006). Cooperation and mutual trust between these three parties has been crucial to the success of a given program.

Confidentiality

Reports submitted to ASAP have been largely confidential. The confidentiality and handling of an ASAP report has depended on whether it met the submission criteria.

Reports which have been a violation of certain regulations have been rejected outright by the ERC and forwarded to the FAA for possible punitive action. The criteria for punitive actions have been:

1. Intentional violations of the Federal Aviation Regulations (FARs).
2. Intentional disregard for safety.
3. Any of the “big five” violations.

(The big five violations have been defined as criminal conduct, substance abuse, use of controlled substances, alcohol use, and intentional falsification; Kelley, 2006).

Confidentiality of ASAP reports has been achieved via de-identification. All data in a report that might point to a specific flight or employee has been stripped by the airline’s ASAP program manager. The program manager has been the gatekeeper for ASAP reports. He or she has been empowered with de-identifying the data, as well as interacting on behalf of the airline with the employee group(s) and/or the FAA. Two instances have existed when the ERC could contact an ASAP report submitter. If the ERC needed more information about the reported incident, or if the ERC decided to individually train or counsel the reporter, then the reporter could be contacted. For all other purposes, reports submitted to ASAP have remained de-identified.

Submissions

Employees have had 24 hours to submit a report from the time they first became “aware of possible noncompliance with 14 CFR (Code of Federal Regulations)” (FAA, 2002, p. 7). Submissions have typically been completed online, although some airlines have had a drop box at the airport where employees could leave handwritten submissions. All submissions have been processed by the air carrier’s ASAP program manager. The

program manager has then forwarded de-identified copies of the report to the ERC, and the ASRS. Reports submitted to the ASRS have been converted into ASRS reports by NASA representatives.

Some reports submitted to ASAP have resulted in timely corrective action. This has been one of the key differences between ASAP and ASRS. In ASRS, all reports have remained completely de-identified and resulted in no more than a database entry. Some ASAP reports have resulted in (a) counseling or training of individuals and/or (b) the publication of, and/or modification to, training procedures that have affected the entire air carrier (or the industry). As an example, Figure 2 has depicted a publication by United Parcel Service (UPS) resulting from their ASAP. This potential for timely corrective action has been one of the more notable advantages of ASAP as compared to the ASRS.

The History of ASAP

In the 1990s, a series of voluntary safety programs based on partnerships between the airlines, the pilot unions, and the FAA emerged. In 1990, USAir started an Altitude Awareness Program for the sole purpose of reporting altitude deviations. Alaska Airlines started a similar program in 1995. American Airlines started their *Aviation Safety Action Partnership* in 1994. This program was based on an agreement between American Airlines, the Allied Pilots Association (APA), and the FAA. The previous altitude awareness programs lasted one year each, accumulated reports numbering in the tens and hundreds, and only included altitude deviations. The American Airlines program lasted 6 years, netted over 22,000 reports, and, most importantly, accepted reports covering all aspects of safety, not only altitude deviations (Kelley, 2006).

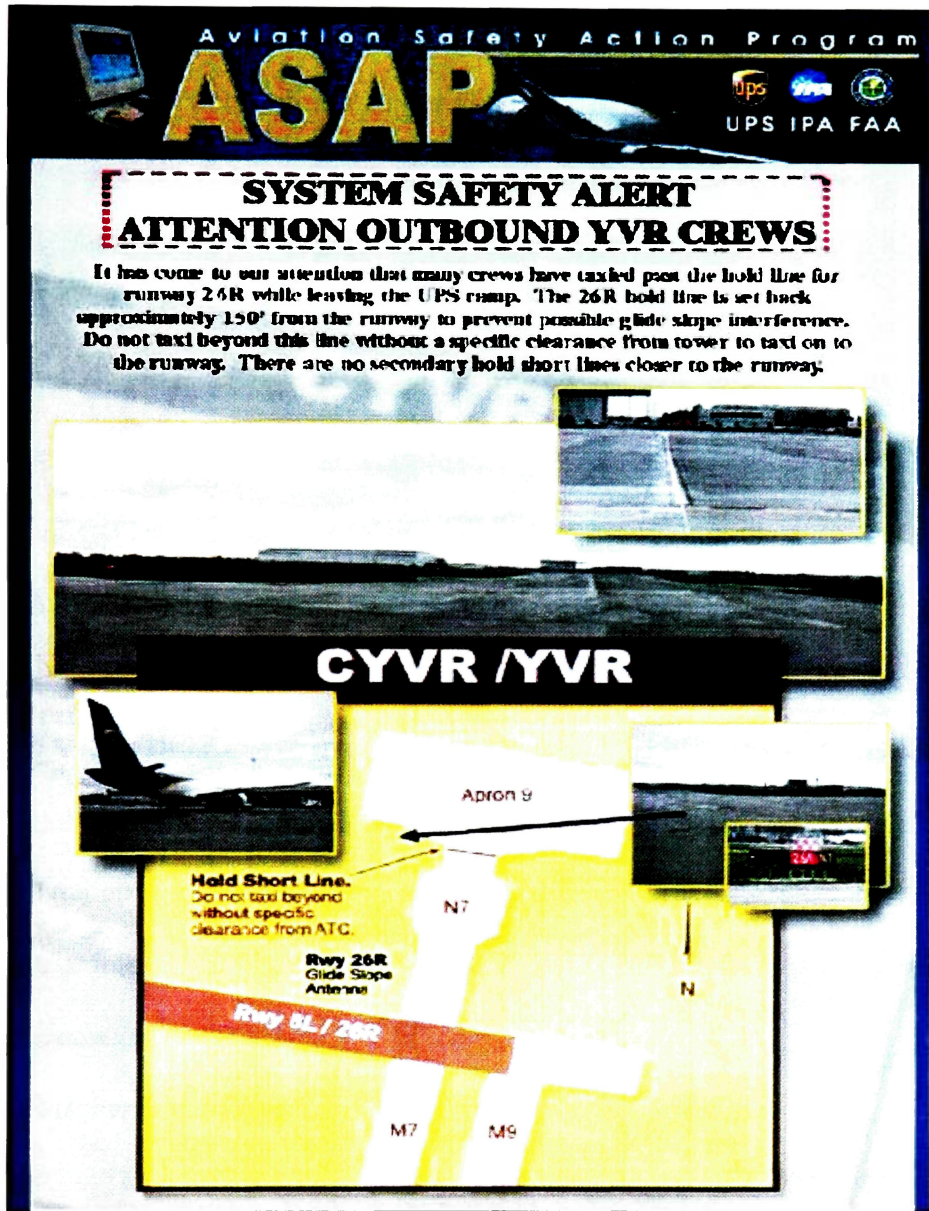


Figure 2. A Corrective Publication Resulting from the UPS ASAP Program (From Fahy, Kom, & Blankenship, 2006).

The success of the American Airlines program prompted the FAA to create Advisory Circular (AC) 120-66 in January 1997, calling for an 18-month demonstration of a common Aviation Safety Action Program. The airlines, unions, and FAA were all satisfied with the outcome of this demonstration. In March 2006, the FAA issued AC

120-66A, which established guidelines for creating an ASAP and opened the program to industry-wide use. The convenience and success of ASAP have generated such a volume of reports that more than half of all ASRS reports originated as ASAP reports.

The Event Review Committee

The ERC has been integral to the ASAP. The ERC has comprised a representative from the air carrier, from the employee group (or labor union), and from the FAA. The FAA representative has been assigned by the Flight Standards District Office. After the ERC has received a de-identified ASAP report from an airline's program manager, the ERC has been able to contact the report submitter (if required for clarification or more data). Depending on the findings, the ERC could handle the issue itself or refer it to the FAA for administrative or corrective action(s). The ERC has been afforded some flexibility as to the handling of issues such as (a) repeat violations and (b) failures to submit an ASAP report when one has been required. However, some issues such as drug use or intentional falsification have been strictly relegated to the FAA and punitive measures (FAA, 2002).

ASAP Performance to Date

The ASAP has been very successful, as evidenced by the fact that no airlines have canceled their MOUs. Many programs have made significant contributions to safety for their airline. The UPS program, as an example, had 87 reports on altitude deviation submitted in the first quarter of 2006 alone. The same program resulted in corrective actions, including the: (a) retraining of an MD-11 crew on proper autopilot usage, (b) updating of a preferred departure routing, and (c) retraining of a marshaller on proper brake release hand signals (Fahy et al., 2006).

Patankar and his colleagues have extensively researched the applications of ASAP. As part of the research, they have gathered extensive data concerning employee attitudes toward ASAP. Patankar and Driscoll (n.d.) found that three times as many employees believed that ASAP increased the atmosphere of trust, as opposed to those who did not. Employees described company disciplinary action as “rare” due to the probable negative backlash of such enforcement action (Yorman, Patankar, & Ma, 2006). The findings of Patankar and colleagues have suggested that ASAP has created its own system of checks and balances.

Relevance to Military Flight Operations

Despite their success in civilian aviation, programs like the ASRS and ASAP have not been used in military flight operations as they have been in air carrier operations. The social and cultural dynamics of military aviation have been too different from its civilian counterpart. As an example, no analogue to the labor union or employee group has existed in the military. While it has been true that military aviators have been able to submit ASRS reports, evidence suggests that the ASRS has been generally misunderstood and under-utilized by them (Elliott & King, 2001). Nevertheless, it has been possible to use some of the important principles of these civilian reporting systems in military systems. These principles have been: (a) a limited exemption from punitive action when an operator reports his or her own error and (b) the use of reports to address errors committed during flight operations.

Operational Hazard Report

ASRS has been available for military use. Additionally, Army Aviation has developed a system for reporting aviation errors to supplement ASRS. This system has

been driven by the Operational Hazard Report (OHR). The OHR “identifies and documents an Aviation hazard before it leads to an accident” (CRC, 2005, p. 5). Additionally, copies of OHRs have been forwarded to the FAA or the National Transportation Safety Board (CRC, p. 16).

The Army designed the OHR to complement and supplement the ASRS. To this end, accident prevention has been the only permissible use for OHRs. Use in punitive action, misconduct investigations, and similar actions has not been permitted by Army Regulation 385-10, which governed the Army Safety Program. Submitters have not been required to provide a name or contact information, but one has been encouraged if a response was desired (CRC, 2005).

Despite the Army’s best intentions, evidence has suggested that the OHR has not been utilized to its potential by Army aviators. Common problems of an OHR program have included:

1. The program being “used, or perceived to be used, for disciplinary actions.”
2. Paying “lip service to complaints [*sic*].”
3. “OHR war [*sic*].”
4. “Lack of emphasis during safety meetings” (CRC, 2005, p. 30).

Just Culture

The key to the success of the FAA’s voluntary safety programs has been the *just culture*. Reason (1997) defined a just culture as “an atmosphere of trust in which people are encouraged or even rewarded for providing essential safety-related information, but in which they are also clear about where the line must be drawn between acceptable and unacceptable behaviour” (p. 23). The just culture that has existed between the FAA, the

airlines, and the unions has existed because of trust. Specifically, the FAA has asserted through a combination of regulations and laws, stated commitment, and historical proof that they will not use data collected through voluntary safety programs as a means of punishing well-meaning safety violators. The effect of the just culture has been circular, in that the perceived equity it creates has built trust, which in turn has made the just culture possible.

The advantages of having a just culture, and the disadvantages of not having one, have been well documented. A study by a Global Aviation Information Network (GAIN) working group identified several benefits of the just culture, including: Increased reporting, trust building, and more effective safety and operational management. These benefits have resulted in many changes which increase the overall level of safety, as well as the efficiency of operations in some cases. Open communication about safety hazards, empowerment of line employees to deal with perceived hazards, and a wealth of additional data about hazards have been some of the benefits. As an example of the effectiveness of the just culture, changes to Denmark's laws regulating the reporting of air traffic control incidents led to an increase from 15 reports in the year prior to the change to 900 reports in the year after (GAIN, 2004).

Summary

The Army has addressed the Shadow's unacceptable accident rate through (a) material solutions and (b) a change in the culture of Shadow operators, termed Aviation rigor (Buford, 2006). However, the systematic identification and addressing of specific operator errors common to line operations, especially before they manifest as accidents, has not been adequately addressed. Civilian self-reporting systems for pilots, notable for

their voluntary and confidential nature, have been extremely successful in identifying similar threats in air carrier operations. It has been unknown if the Army's OHR system, analogous to the ASRS, has been effective in meeting this requirement, especially in Shadow flight operations. The just culture created by self-reporting programs has demonstrated benefits in terms of error reporting and improvement of the organizational safety culture.

Research Questions

The review of the literature has resulted in the following research questions:

1. Are operator errors going unrecognized due to a fear of punishment?
2. Do Shadow operators have any acceptable means of reporting their own errors; if so, are these means utilized properly?
3. What challenges exist in implementing a self-reporting system for Shadow operators?
4. How important is confidentiality to establishing a self-reporting system for Shadow operators?

Chapter III

METHODOLOGY

This study gathered data from Shadow operators using a combination of two instruments: a survey and an interview. The survey gathered the demographics of the sample and determined the perception of a need for a voluntary, confidential self-reporting system for operator errors in Shadow flight operations. The survey also identified cases that needed further exploration. Cases were identified as candidates for interview based on the researcher's judgment. The data from the survey and interview instruments were then interpreted to determine the need for, and challenges to, implementation of a self-reporting system for Shadow operators.

Research Technique

The study employed mixed-methods research techniques, utilizing both quantitative and qualitative data. Data gathering took place in two distinct phases: a survey instrument, and a series of semistructured interviews. This approach was chosen because it coupled the strengths of a survey instrument (more easily defined data and ease of administration) with the detailed responses, flexibility, and useful anecdotal data of interviews (Creswell, 2003).

The survey had two distinct categories of items. The first category of items collected the demographics of the sample. The second category gathered Likert scale and other closed question data on the perceived need for and opinions regarding a self-reporting system for Shadow operators. In that regard, the survey phase resembled a

concurrent nested research strategy. The second phase, the interview phase, sought to elaborate on the opinions and experiences of survey participants needing further examination. In this sense, the overall two-phase approach resembled the sequential explanatory research strategy (Creswell, 2003). The sequential explanatory strategy has gathered quantitative data first, such as the closed question survey items, and then used qualitative data gathering methods like the interview to explore some of the quantitative data further.

The approach used in this study differed from a standard sequential explanatory strategy in that the survey-driven first phase had not been completed for the entire sample before the interviews were administered. Rather, interviews were administered once a cluster's (i.e., platoon's) survey phase was complete. In this sense, the survey-interview cycle occurred recursively for each cluster or platoon studied as part of the greater sample. This research design, although complex, was determined by the researcher to be the best means of exploring the subject. The researcher felt that the survey would: (a) increase the power of the study by increasing the sample size as compared to a strictly qualitative instrument, (b) increase the credibility of the study by offering quantitative data, and (c) assist in identifying appropriate participants to be interviewed. The interviews allowed for the exploration of subtexts that might not have been revealed by the survey, as well as a greater depth of responses than were offered by the survey. The overall study was exploratory in nature, and was guided by the theoretical perspective of identifying error through the use of self-reporting systems.

Research Design

Shadow operators were enlisted soldiers and non-commissioned officers in the U.S. Army. Operators, per doctrine, constituted 14 personnel of a 23 Soldier platoon. More than 50 operational platoons existed in the Army, with the planned fielding being 94 platoons (Kappenman, 2006). The U.S. Army perceived a need for reducing the erring propensity of Shadow operators, citing such factors as the absence of manned aircraft qualification from operator training and the lack of Aviation rigor in the Shadow community (Buford, 2006). The use of voluntary and confidential self-reporting systems was selected as a possible tool to augment this error reduction strategy due to its apparent success in the air carrier industry.

The researcher was an Aviation Officer in the U.S. Army, and was experienced as an enlisted Shadow operator (to include a short combat tour in the Middle East). The researcher earned Instructor Pilot and Mission Commander qualifications while serving as a Shadow operator; graduate studies at Embry-Riddle Aeronautical University were focused on aviation safety. Coursework was augmented by participation in an FAA safety conference as well as membership in the International Society of Air Safety Investigators, an organization for aviation safety professionals.

Survey Sample

Shadow operators have been both the participants and the beneficiaries of a prospective voluntary and confidential self-reporting system. As such, they were chosen as the population from which to draw a sample for the study. The researcher's intent was to influence the sample of Shadow operators to ensure an adequate level of experience. Shadow operators without experience in an operational unit (i.e., one that had performed

combat missions) were judged to be too inexperienced to have useful opinions regarding a self-reporting system. Thus, inexperienced operators who had not graduated from the introductory Army UAV operator's course at Ft. Huachuca, Arizona were omitted from the sample. The researcher desired a majority of the participants to have had combat experience as UAV operators, and for half of all participants to have qualifications in positions such as Mission Commander (MC), Instructor Pilot (IP), Crew Chief (CC), and Standardization Pilot (SP).

The surveyed and interviewed operators were mostly found in Shadow platoons supporting combat units throughout the Continental United States. In addition to these operators in combat-operational units, operators in institutional units with previous experience in combat units were also studied. A convenience sample was selected, as at the time of study, the majority of combat Shadow platoons were deployed in support of the Global War on Terror. The units studied were located by Web search on official Army unit sites; platoons participated because they were cooperative and available for the study. (Only platoons within the Continental United States were chosen due to limited travel resources.)

The survey was administered to 38 operators. The survey sample size of 38 represented 5% of an estimated total population of 700 Shadow operators in combat units. The estimate of 700 Shadow operators was determined by multiplying the 14 operator positions in a fully manned platoon by the estimated 50 platoons fielded in the U.S. Army in 2006 (Kappenman, 2006). This estimate of 700 was also reasonable when measured against a total population of 838 Army UAV operators, which included both Shadow operators and RQ-5 Hunter operators, as the majority of Army UAV operators

are Shadow operators (C. Damboise, personal communication, April 4, 2007). More than half of the respondents (52.63%) were not veterans of a combat tour as a UAV operator either in Iraq or Afghanistan.

Of the 38 participants that completed a survey, 11 were selected for further examination in an interview. These 11 participants were selected for interview based on the researcher's judgment, and on responses to the open-ended item concerning errors the operator had made, and in some cases, not reported. Of the interviewees, eight were Instructor Pilot qualified and eight (not the same sample as the IPs) were veterans of a combat tour in either Iraq or Afghanistan.

Study Design

The survey and interview questions were developed specifically for the study; the instruments were designed to complement each other. The survey items and interview questions were designed to investigate the study's research questions.

The Survey

For the survey, no pilot study or pretest was determined to be necessary. This decision was based on confidence in the effectiveness of the instrument as well as the infeasibility of such a pretest or pilot study. A pretest was infeasible because the studied population, Shadow operators, were not present locally. The closest Shadow platoon to the researcher's home was at Ft. Stewart, Georgia, more than 200 miles distant. A copy of the survey questionnaire has been included as Appendix A.

The survey questionnaire was divided into three sections: (a) demographics of the respondents, (b) Likert scale and other closed question items on attitudes regarding implementation of a self-reporting system, and (c) one open-ended item on the same.

Validation of the instrument was conducted with the assistance of the thesis committee chair.

The Interviews

The interview questions were developed so as to exploit relevant information suggested by the survey and generate in-depth, detailed qualitative anecdotes on the subject of the implementation of a self-reporting system. The interview questions were intended to provide prompts as a supplement for the researcher. The researcher's primary qualitative technique was to allow participants to direct the dialogue and ask questions in response to the participants. The interview questions have been provided as Appendix B.

Cover Letter

Before the survey was administered, a cover letter was distributed to each participant, including:

1. The purpose of the study.
2. That the study was voluntary.
3. That all responses were confidential, and all participants would remain anonymous.
4. That the study was not affiliated with the Army or Department of Defense.
5. That the researcher was available to answer any questions.
6. That a voluntary interview could have been conducted after the survey.

This cover letter to the participants has been provided as Appendix C.

Data Gathering Methods

Surveys and interviews were administered in person during visits to Shadow platoons on Army posts. These visits were arranged and scheduled in advance. They were coordinated through the participating unit's platoon leader, and were scheduled so as to

minimize the impact on scheduled training activities for the participating unit. Permission was obtained to administer the surveys and interviews through proper coordination with the participating units' chains of command. The surveys and interviews were administered between March 19 and March 23, 2007.

The surveys were administered to operators as they were afforded the opportunity to complete the survey during the work day. The researcher verbally briefed the participants on the proper completion of the survey. The surveys were conducted in the most private, distraction-free environment as could be found at the time; sites included an unused classroom, the outside wall of a hangar, and the unit's motor pool. Care was taken to ensure that participant privacy was maintained.

Interviews were conducted under the same conditions as the surveys. Surveys with responses indicating a possibility for further exploration were used as a means of selecting interview candidates. The interview locations were subject to the limitations of the ongoing work day for the participants. A less formal and more relaxed atmosphere was developed via the camaraderie facilitated by the researcher's Shadow experience, thereby encouraging candidness and disclosure by the interviewees. (The researcher also introduced himself as a graduate student and eschewed military uniform and rank.) The interview questions were only used when the researcher felt the need to employ a prompt. Respondents were encouraged to discuss whatever they felt was relevant; questions asked by the researcher were more often follow-up questions to the responses than selected from the list of interview questions. This was chosen as the most effective means of gleaned information from the interview that might otherwise not have been obtained.

Treatment of the Data

Completed surveys were examined to determine their usability. Responses from the survey were entered into a Statistical Package for the Social Sciences (SPSS) database for storage and analysis. The quantitative survey responses were treated for correlation with the non-parametric Spearman's rho (r_s).

Qualitative responses were analyzed by the researcher in order to verify the intended meanings. Once the meanings of the qualitative responses were determined, responses were grouped together into common themes. The number of occurrences of responses following a given theme was tabulated.

Chapter IV

RESULTS

This study used a survey as the primary data-gathering instrument. The survey was augmented by a follow-up interview. Respondents were selected for follow-up interview based on their responses to the survey and the judgment of the researcher.

The survey comprised 28 items, with each item prompting only one response except for the 9th item, which required a total of four responses. Items 12 to 15 determined the participant's perceived exposure to common operator errors such as altitude deviations or skipped checklist items. Items 16 to 27 were used to measure the participants' attitudes and experiences regarding error reporting. Item 28 was open-ended, and allowed the respondent to describe any errors he may have observed and not reported.

The allowance for open-ended responses to Item 28, as well as the follow-up interviews, provided anecdotal data, explored unusual responses, and enabled the participant to elaborate upon certain responses. The follow-up interviews were guided by a series of interview questions, although the interview questions were followed loosely, as the respondents often did not require much prompting.

Demographics

Items 1 to 11 were used to determine the demographics of the participants. Factors such as the respondent's level of experience and qualifications were measured.

Demographic 1: Age of Participants

Participants' ages ranged from 19 to 46 years. Two respondents out of 38 neglected to list an age. The mean (M) age of participants was 25.44 years, with a standard deviation (SD) of 5.56 years; only two respondents did not fall within one SD of the M . Of the respondents, 94.44% fell between the ages of 19 and 31. Figure 3 has depicted the age distribution of participants who listed an age.

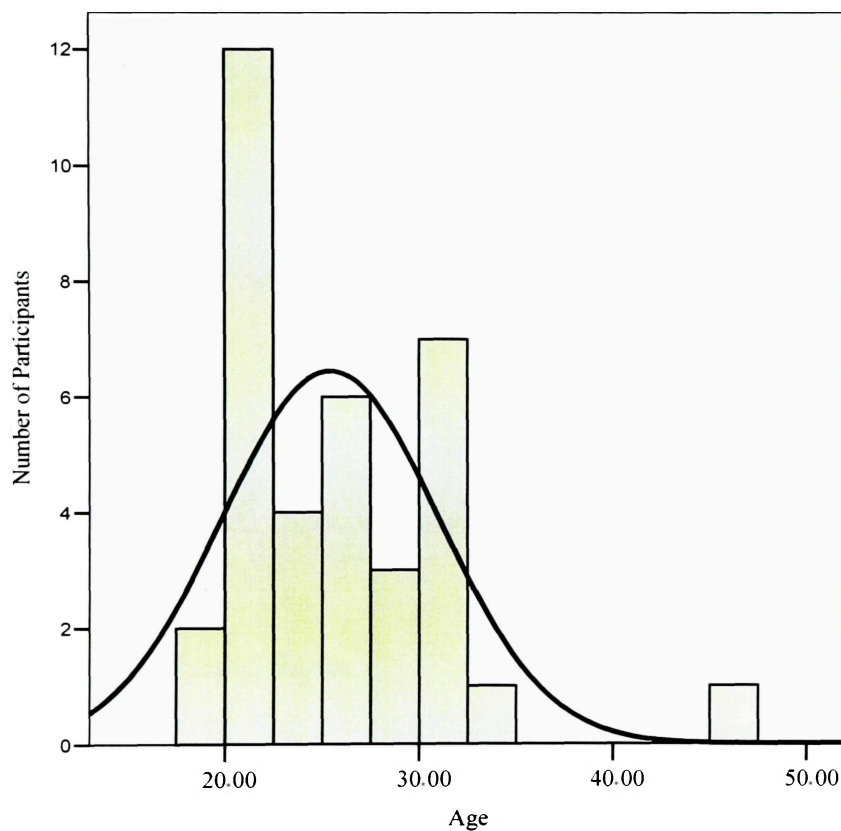


Figure 3. Participants' Age Distribution.

Demographic 2: Rank of Participants

Participants held ranks ranging from Private First Class (PFC) to Warrant Officer (WO1). The most common rank was PFC, followed by Staff Sergeant (SSG) and

Sergeant (SGT). The sample also consisted of two Corporals (CPL), a Specialist (SPC), and a Warrant Officer (WO1), who had recently been an enlisted UAV operator. Three individuals elected not to list a rank. Figure 4 has depicted the ranks of participants.

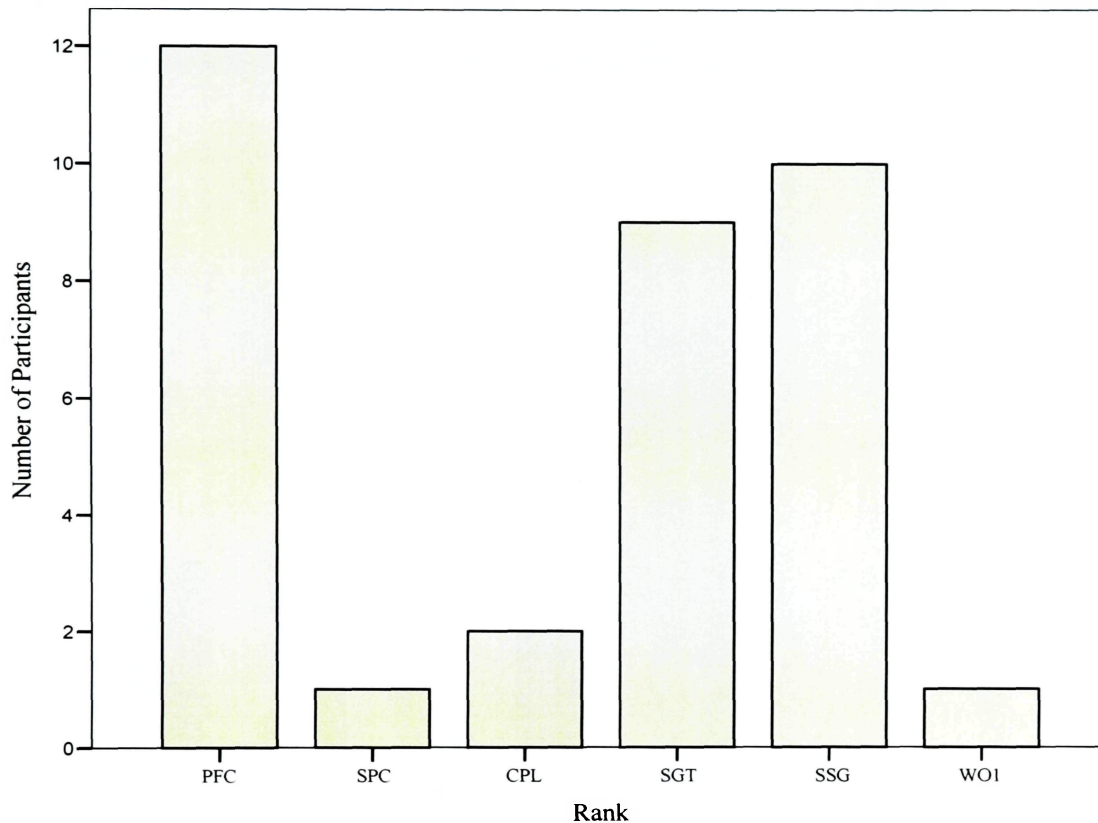


Figure 4. Participants' Ranks.

*Demographic 3 and 4: Readiness Level as an Air Vehicle Operator
and as a Mission Payload Operator*

The currency and proficiency of Army Aviators has been measured by their Readiness Level (RL). The same has been true of UAV operators. Readiness Level One (RL1) has indicated that the operator is fully proficient and ready to fly without an Instructor Pilot. Conversely, Readiness Level Three (RL3) has been the lowest level of readiness for an operator who has completed the UAV operator's course. Readiness

Level 2 (RL2) has indicated that progress has been made towards RL1, but that the operator has not reached that level of readiness yet. Shadow operators have progressed separately as an Air Vehicle Operator (AVO), controlling the flight of the aircraft; and as a Mission Payload Operator (MPO), controlling the aircraft's payload, typically a camera. Figure 5 has depicted the RL of the participants as AVO and MPO.

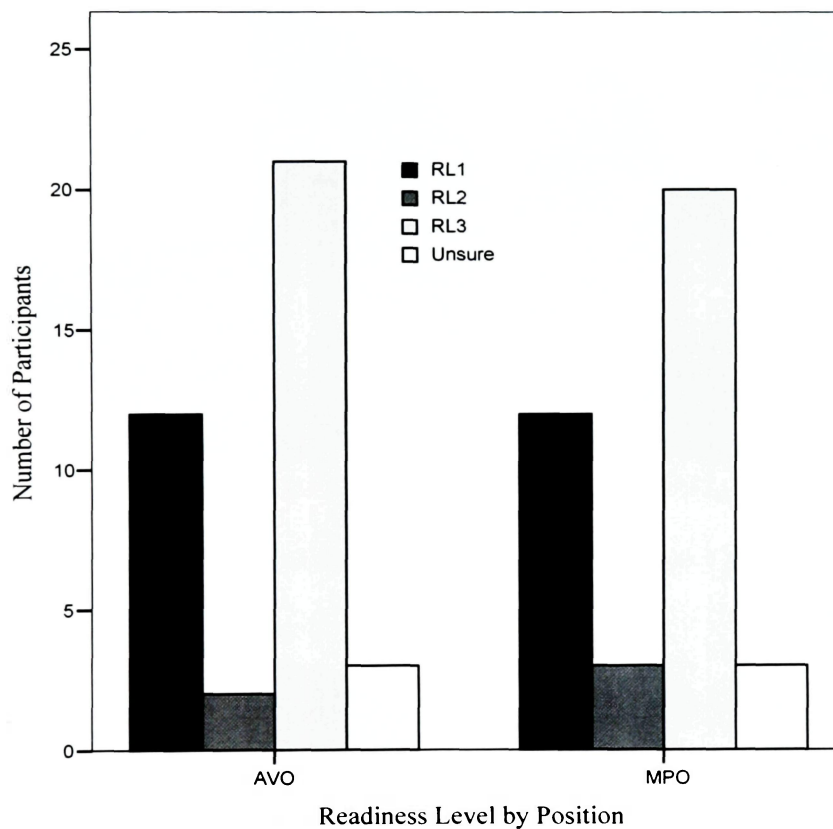


Figure 5. RL as AVO and MPO.

Of the participants, 55.26% were RL3 as AVOs and 52.63% were RL3 as MPOs. RL1 was the next most common for both positions, with 31.58% for both MPOs and AVOs. Every participant listed a readiness level.

Demographics 5 through 8: Qualifications

Shadow operators have performed duties in addition to AVO and MPO. These duties have included Instructor Pilot (IP), Mission Commander (MC), Crew Chief (CC), and Standardization Pilot (SP). Figure 6 has depicted IP and SP qualifications among respondents, and Figure 7 has depicted MC and CC qualifications among the same.

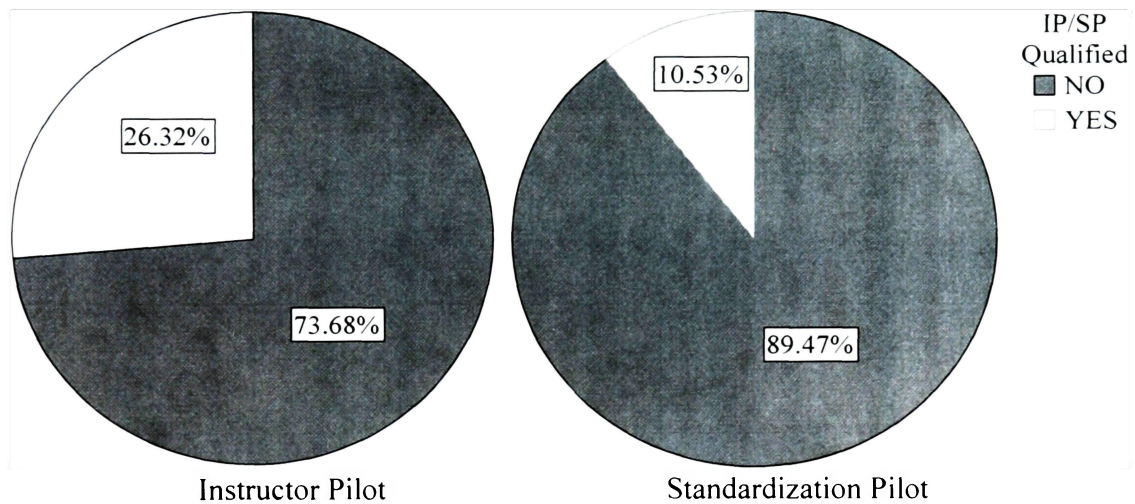


Figure 6. Breakdown of Instructor and Standardization Pilot Qualified Operators.

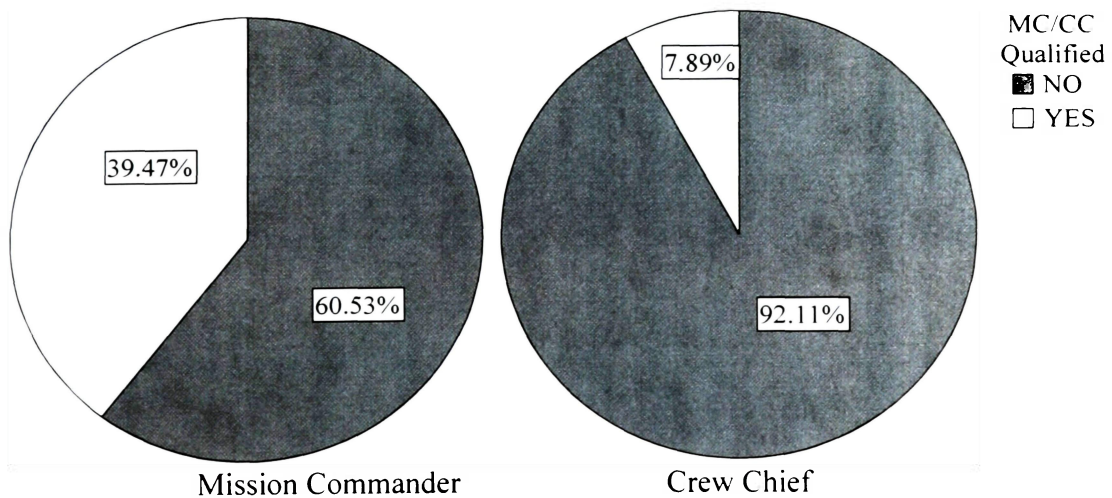


Figure 7. Breakdown of Mission Commander and Crew Chief Qualified Operators.

The most common qualification was MC, charged with directing missions, followed by IP, charged with instructing other operators. Less than eight percent of operators were Crew Chief qualified. All participants responded to all four items.

Demographic 9: Hours Logged by Position

Item 9 determined approximately how many hours participants had logged at the AVO, MPO, MC, and CC positions. Responses ranged from 0 to 1500 hours for AVO and MC. MPO hours ranged as high as 900. CC time was considerably lower with the highest value being only 7 hours. Only five participants listed any CC hours. Figure 8 has depicted the hours of participants at the AVO position. The M for the 37 participants who responded was 280.49 hours as AVO. One participant did not list hours for any of the four positions.

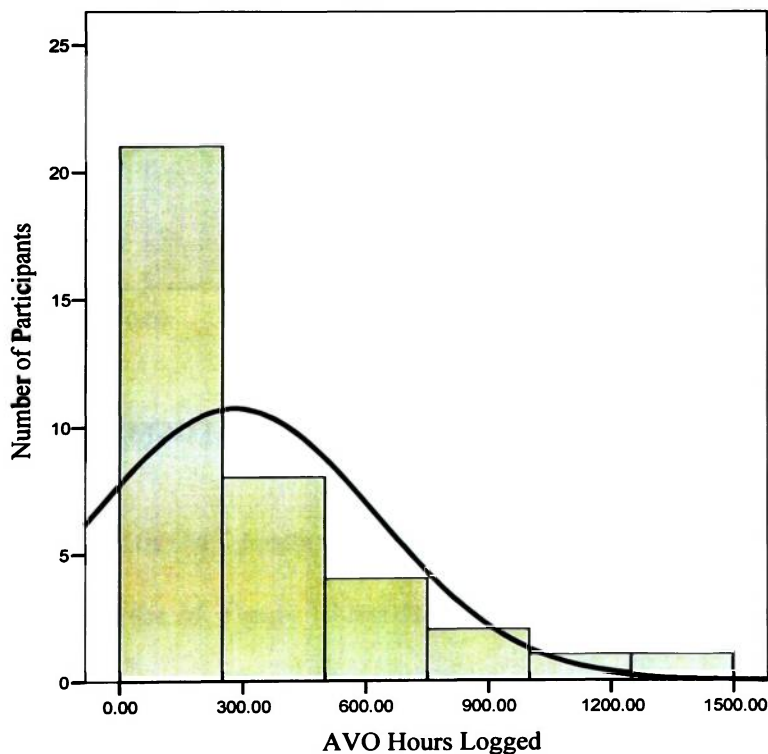


Figure 8. AVO Hours Logged.

The M for MPO hours was 232.38. Figure 9 has depicted the hours participants reported as MPO. More than half of the 19 participants with MPO hours that ranged from 0 to 100 had recently graduated from the UAV operator's course, and had insufficient opportunities to accrue MPO hours.

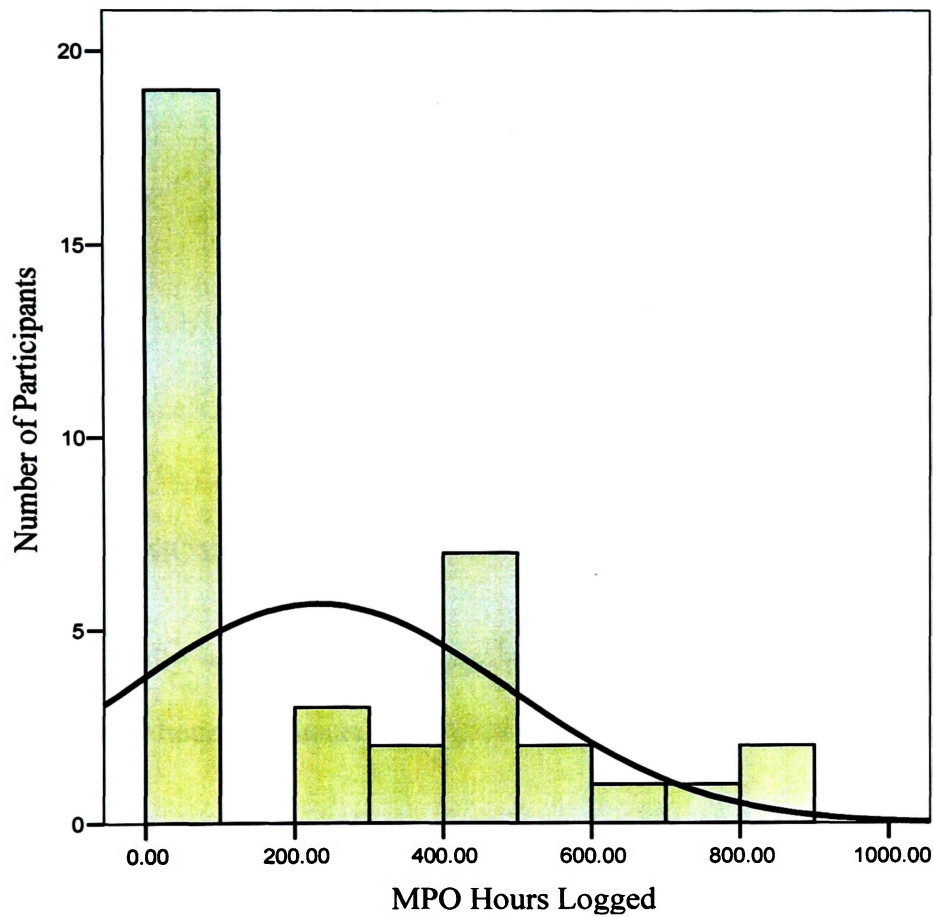


Figure 9. MPO Hours Logged.

At the MC position, participants listed less hours on average than at AVO, with 211.21 as the M . Figure 10 has depicted hours reported by participants as MC.

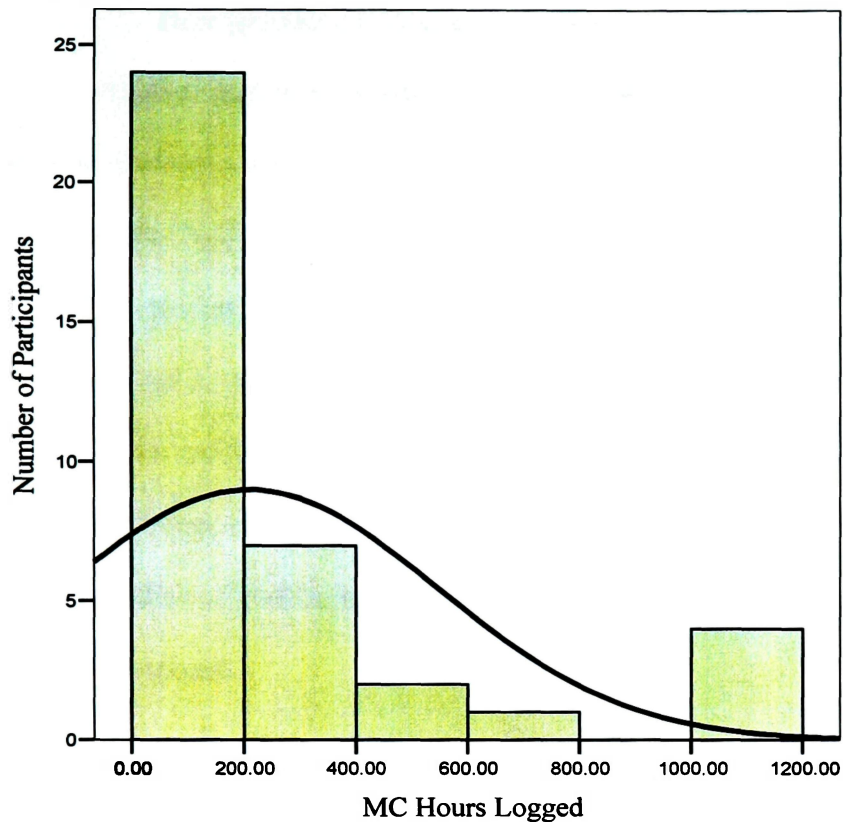


Figure 10. MC Hours Logged.

Finally, with only five participants listing any CC hours and all responses being less than 10 hours, CC hours were determined to be insignificant for the purposes of this study.

Demographic 10: UAV Operator Duties in a Combat Theatre

Item 10 sought to determine if the participant had performed UAV operator duties in a combat theatre. In the Army, combat experience has been an important measure of a Soldier's experience level. The item prompted a simple yes or no response, and 47.37% of participants reported that they had performed UAV operator duties in combat.

Demographic 11: Graduation Date from UAV Operator's Course

Another important measure of a UAV Operator's experience level has been how long he has been a qualified operator. All Shadow operators have been required to complete the Tactical UAV (TUAV) Operator's Course at Ft. Huachuca, Arizona. Item 11 was an open-ended item allowing participants to list their graduation date from the aforementioned course. The graduation dates have allowed the researcher to determine how long the participants have been qualified operators. This metric has been one additional means of measuring the participants' experience levels. Figure 11 has depicted the distribution of graduation dates among the study participants. Two participants did not list a response.

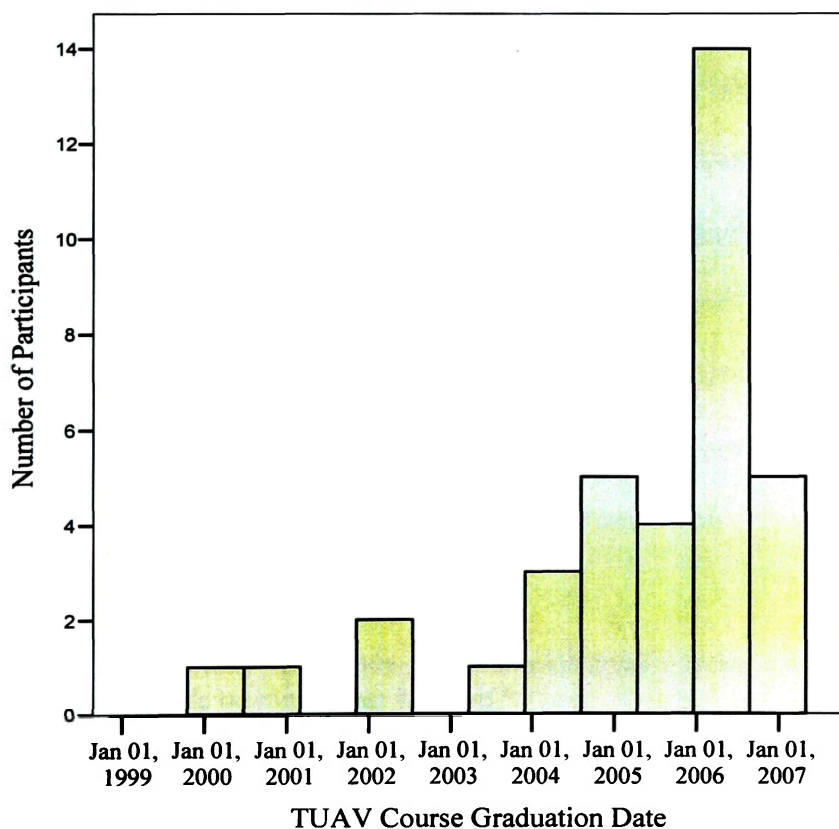


Figure 11. Graduation Dates from UAV Operator's Course

The most common graduation date for the participants was June 29, 2006. Of the participants, 63.89% graduated after June 7, 2005. The earliest graduation date was June 25, 2000, and the most recent was December 14, 2006.

Research Items

Items 12 to 28 sought to address the study's research questions (stated at the end of Chapter II). All of these items asked the participant to circle a response which best fit their experiences except for item 28, which was open-ended. Items 12 through 15 asked the participant to list their experience with four varieties of in-flight hazard, with possible responses of never, few, and several. No quantities were given for never, few, or several; instead, it was left to the respondent to determine which was most appropriate.

Items 16 through 25 were Likert scale items determining the participants' attitudes regarding various aspects of error reporting. Possible responses were Strongly Agree (SA), Agree (A), Neither Agree nor Disagree (N; Neutral), Disagree (D), and Strongly Disagree (SD). Responses were assigned numerical values to aid in analysis, thus: SA = 1, A = 2, N = 3, D = 4, and SD = 5. Items 26 and 27 were yes or no items determining if the participant had ever not reported an observed error. Written responses to item 28 were followed up with an interview and data from the two sources has been indistinguishable. All closed question items were answered.

The phrasing of items 12 to 28 was:

12. How many times have you ever accidentally flown outside of your assigned altitude by more than 300 feet?
13. How many times have you ever accidentally flown outside of your assigned airspace by more than 0.5 km?

14. How many times have you ever accidentally skipped a checklist item?
15. How many times have you ever made any other type of error that would endanger the UAV, other aircraft, or any personnel on the ground? (Feel free to describe the incidents on the back).
16. If I made one of the errors listed in items 12 - 15 and no one else saw it happen, I would not tell anyone.
17. If I saw another operator make one of the errors listed in items 12 - 15 and no one else saw it happen, I would cover for him/her and not tell anyone.
18. If my chain of command (Squad Leader, PSG, PL, etc) found out that I made one of the errors listed in items 12 – 15, there would be negative consequences.
19. If a Mission Commander, Instructor Pilot, or the Standardization Pilot found out that I made one of the errors listed in items 12 – 15, there would be negative consequences.
20. Our Instructor Pilot and/or Standardization Pilot helps us learn from our mistakes.
21. I am familiar with the Occupational Hazard Report.
22. My platoon makes effective use of the Occupational Hazard Report.
23. My platoon has an effective system for reporting hazards, errors, and incidents.
24. If I made an honest mistake and I knew there would be no negative consequences, I would report making one of the errors listed in items 12-15.
25. I would report making one of the errors listed in items 12-15 if I could report it completely anonymously.
26. Have you ever made one of the errors listed in items 12-15 and did not tell anyone?
27. Have you ever seen someone else make one of the errors listed in items 12-15 and did not tell anyone?
28. If you answered “yes” to item 26 or item 27, please describe what happened below. If necessary, continue on the back.

Items 12 through 15: Operator Errors

Before the reporting of errors was investigated, the propensity of the operator to error has been considered. Accordingly, items 12 through 15 sought to determine how often the participants had made some of the more common Shadow operator errors. All items allowed responses of never, few, and several.

Item 12 asked the participant how many times he had accidentally flown off of their assigned altitude by more than 300 feet. Responses to item 12 are described in Figure 12.

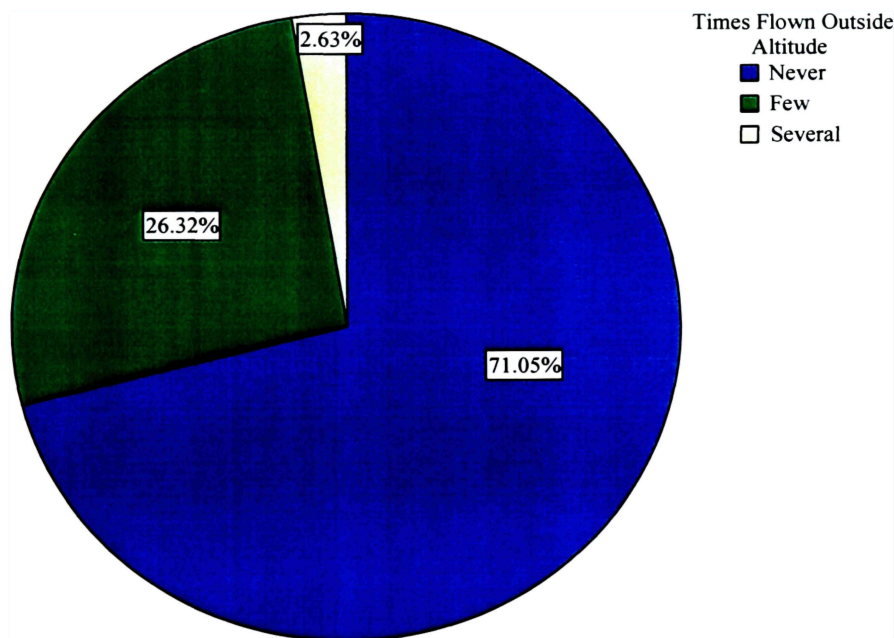


Figure 12. How Often the Participant Flew Outside of the Assigned Altitude.

Item 13 asked the participant how many times he had accidentally flown off of their assigned airspace by more than 0.5 kilometers. Responses to item 13 are described in Figure 13.

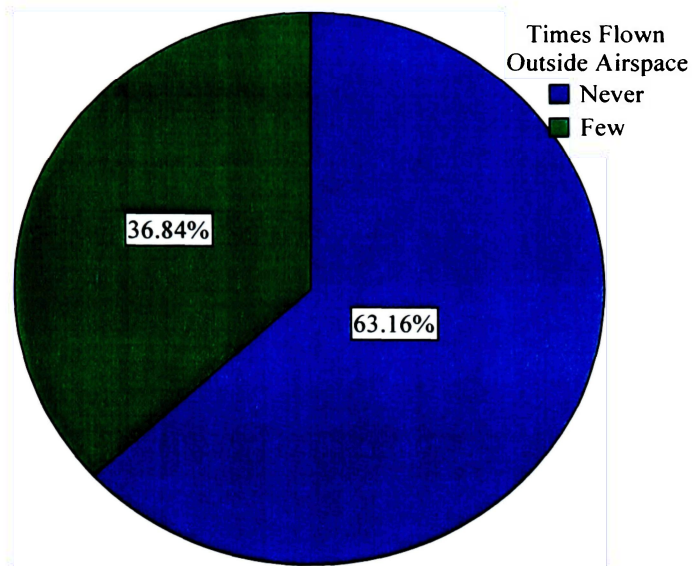


Figure 13. How Often the Participant Flew Outside of Assigned Airspace.

Skipped checklist items were addressed by item 14, which asked the respondent to describe how many times he had made such an error. Item 14 has been depicted by Figure 14.

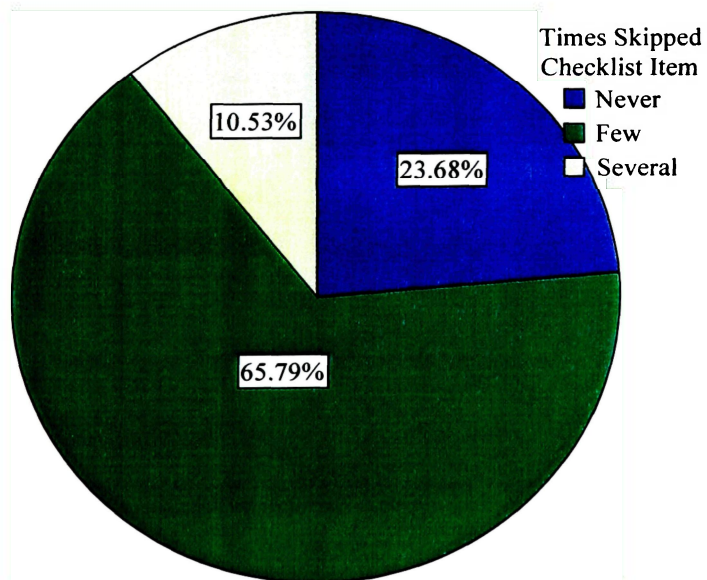


Figure 14. How Often the Participant Skipped a Checklist Item.

Occurrences of any other errors that might endanger the UAV, other aircraft, or personnel on the ground were determined by item 15, which also encouraged the respondent to describe the error on the back of the survey. Open-ended responses were combined with the data from item 28 and the interviews. Quantitative responses to item 15 have been depicted by Figure 15.

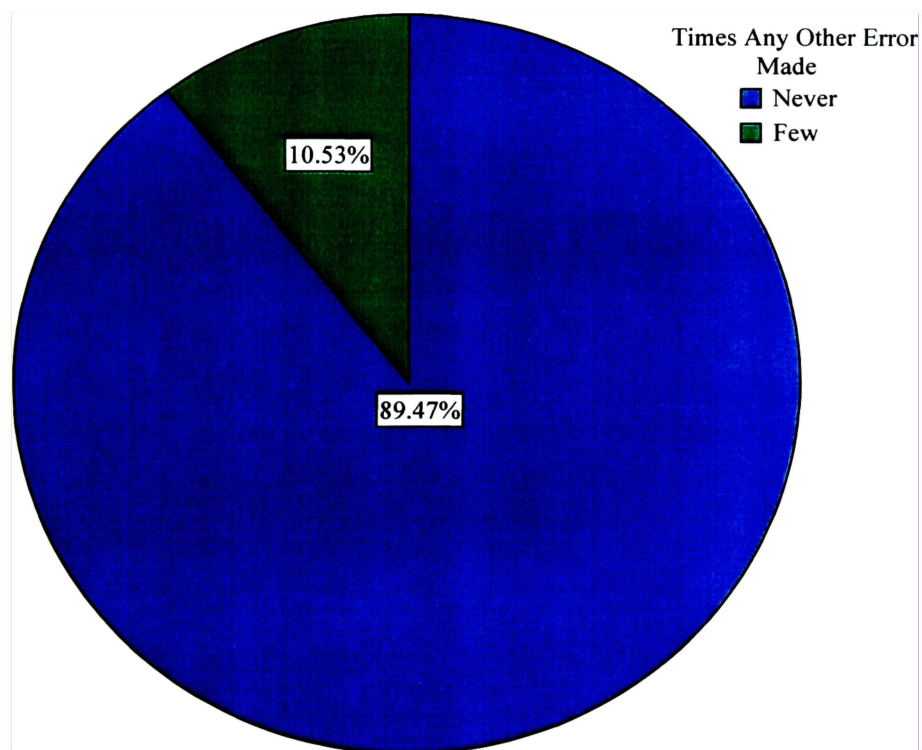


Figure 15. Occurrences of Any Other Error.

Items 16 and 17: Response to Observed Errors

Items 16 and 17 measured the participant's attitude towards reporting an observed error, assuming no one else saw the error happen. Item 16 asked the participant if he would tell anyone if he made one of the errors described in items 12 through 15. The

participants' responses were 73.68% Disagree (D) or Strongly Disagree (SD) for item 16.

Results for item 16 have been depicted by Figure 16.

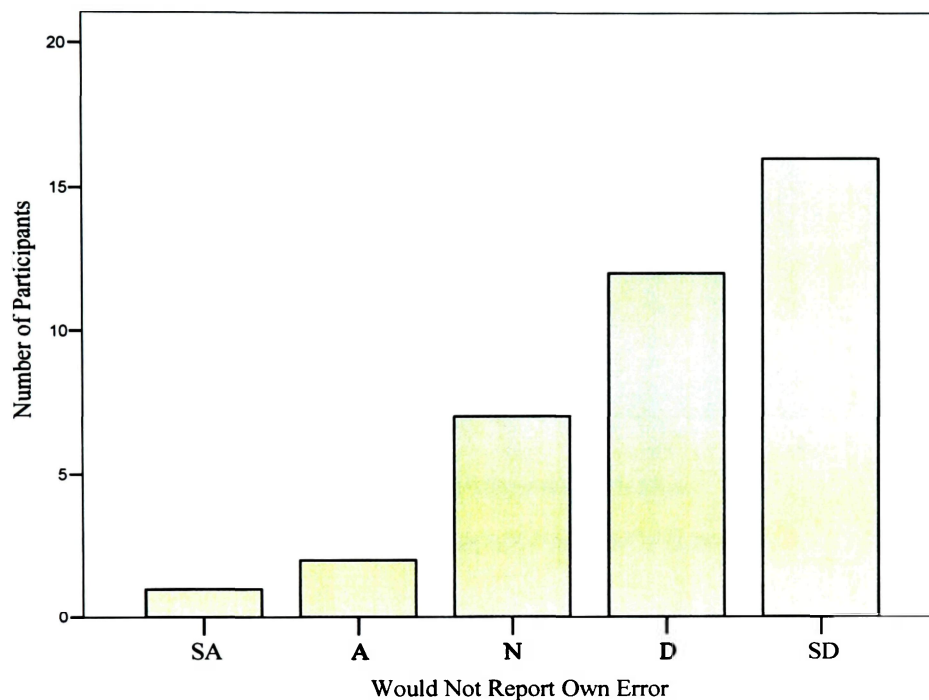


Figure 16. Participant Would Not Report Own Error.

Item 17 asked the participant if he would tell anyone if he observed another operator make one of the errors listed in items 12 through 15. Results for item 17, concerning reporting another's error, have been similar to those for item 16, with 76.32% of participants having chosen D or SD. For both items, more than 70% of participants selected D or SD in response to not reporting an observed error. Results for item 17 have been depicted by Figure 17.

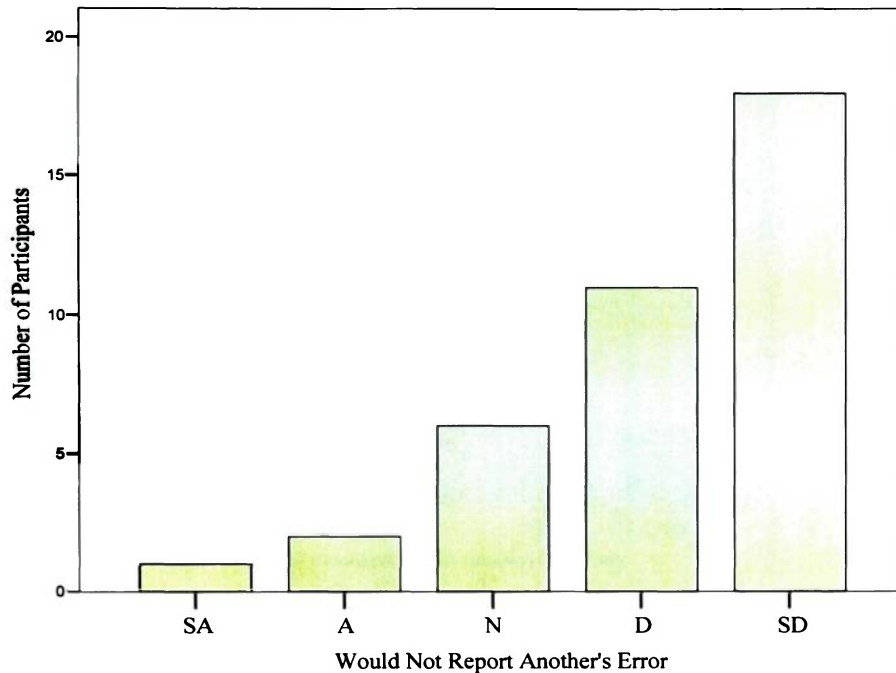


Figure 17. Participant Would Not Report Another's Error.

Items 18 and 19: Leadership's Handling of Errors

In a Shadow platoon, there have been multiple authorities that an operator must respond to. The chain of command has consisted of traditional leadership positions such as the Squad Leader or Platoon Leader. In item 18, for the purposes of simplification, the Platoon Sergeant was also included in the chain of command despite the fact that he has fallen under the Non-commissioned Officer (NCO) support channel. Other leaders that a Shadow operator has been accountable to have included MCs, IPs, and the platoon's SP.

Item 18 asked the operator if there would be negative consequences if the chain of command found out that the operator made one of the errors described in items 12 through 15. If their chain of command found out about one of the errors described in items 12-15, 57.89% of participants felt that there would be negative consequences.

Figure 18 has depicted the results for item 18.

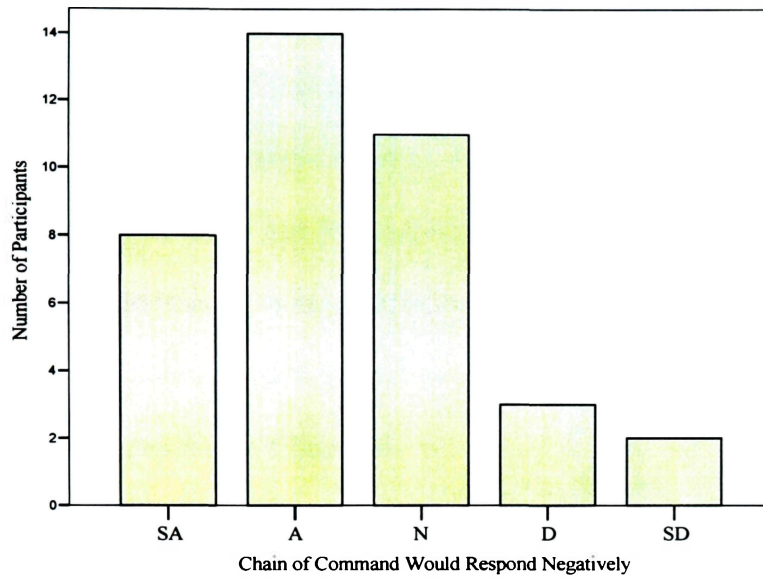


Figure 18. Participant's Chain of Command Would Respond Negatively to an Error.

Item 19 asked the operator if there would be negative consequences if the MC, IP, or SP found out about the same errors as in item 18. Of the participants, 63.16% felt that there would be negative consequences if the MC, IP, or SP discovered the listed errors.

Figure 19 has depicted responses to item 19.

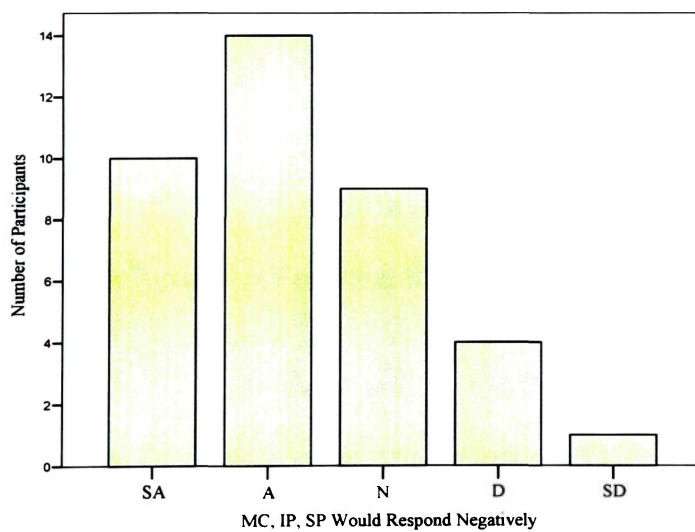


Figure 19: Participant's MC, IP, or SP Would Respond Negatively to an Error.

Item 20: IP and SP Role in Learning from Mistakes

A key facet of the operator's attitude towards error has been his perception of how the IP or SP would respond to error. Item 20 sought to determine how the operator perceived how the IP and SP would use errors. It asked the participant if the IP and/or SP help the operators to learn from their mistakes. Participants chose SA or A, that the IP and or SP helps operators learn from mistakes, in 89.47% of cases. Responses to item 20 have been depicted in Figure 20.

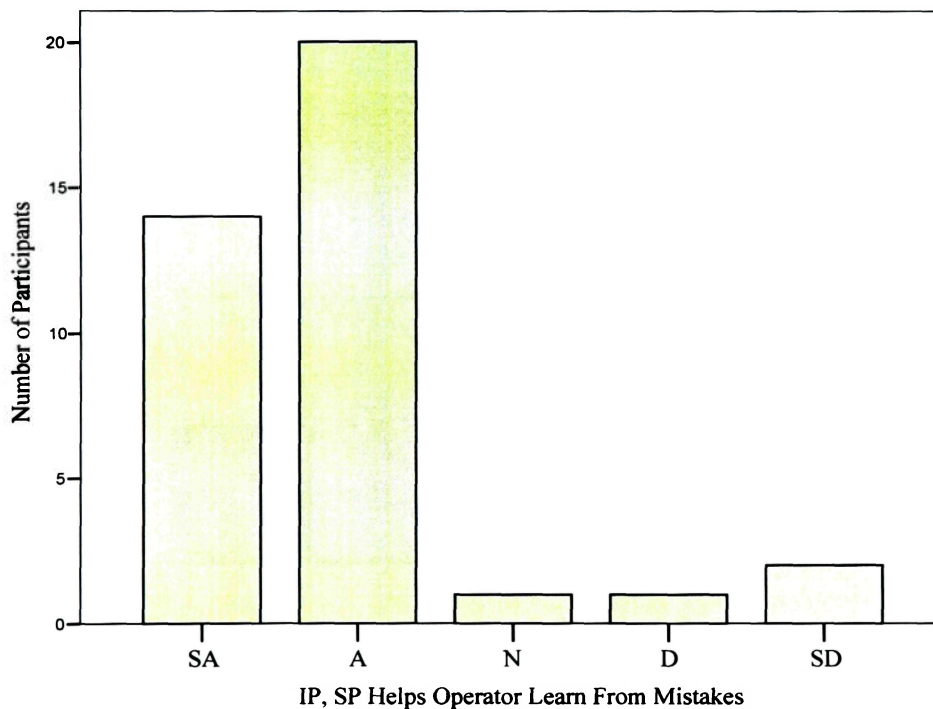


Figure 20. Participant Feels that IP or SP Helps Operators Learn From Mistakes.

Items 21 and 22: The Operational Hazard Report

The OHR has been an Army mechanism for reporting non-accident data. Determining if the existing OHR is used correctly and effectively has been a vital step toward developing a functional voluntary and confidential error reporting system specific

to Shadow operations. Items 21 and 22 addressed this issue. Item 21 asked the participant if he was familiar with the OHR. Exactly 50% of participants agreed or strongly agreed that they were familiar with the OHR. An additional 11 participants (28.95%) neither agreed nor disagreed that they were familiar with the OHR. Figure 21 has depicted results for item 21.

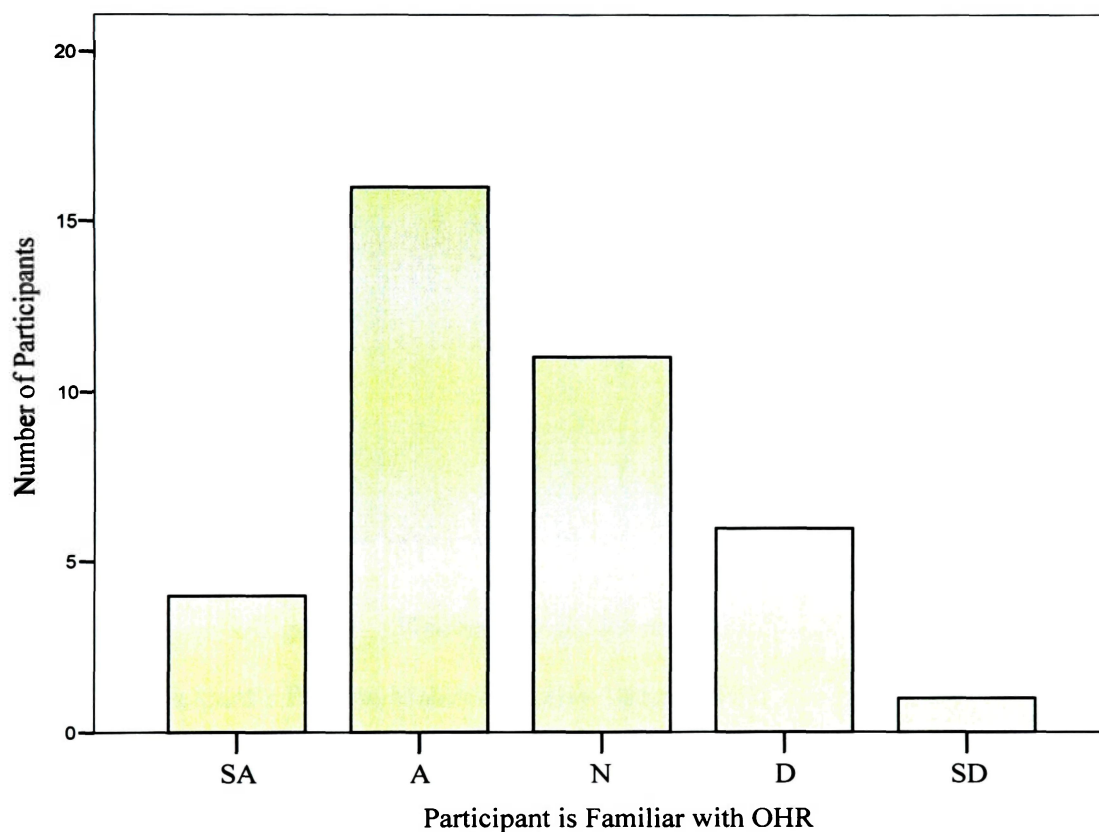


Figure 21. Participant Is Familiar with the OHR.

Item 22 asked if the participant's platoon made effective use of the OHR. Participants agreed or strongly agreed with the sentiment that their platoon makes effective use of the OHR by the same margin that they selected the neutral option. In both cases, 47.37% of participants chose the respective options: SA and A for the former, N

for the latter. More participants chose neutral than any other option. Results for item 22 are depicted by Figure 22.

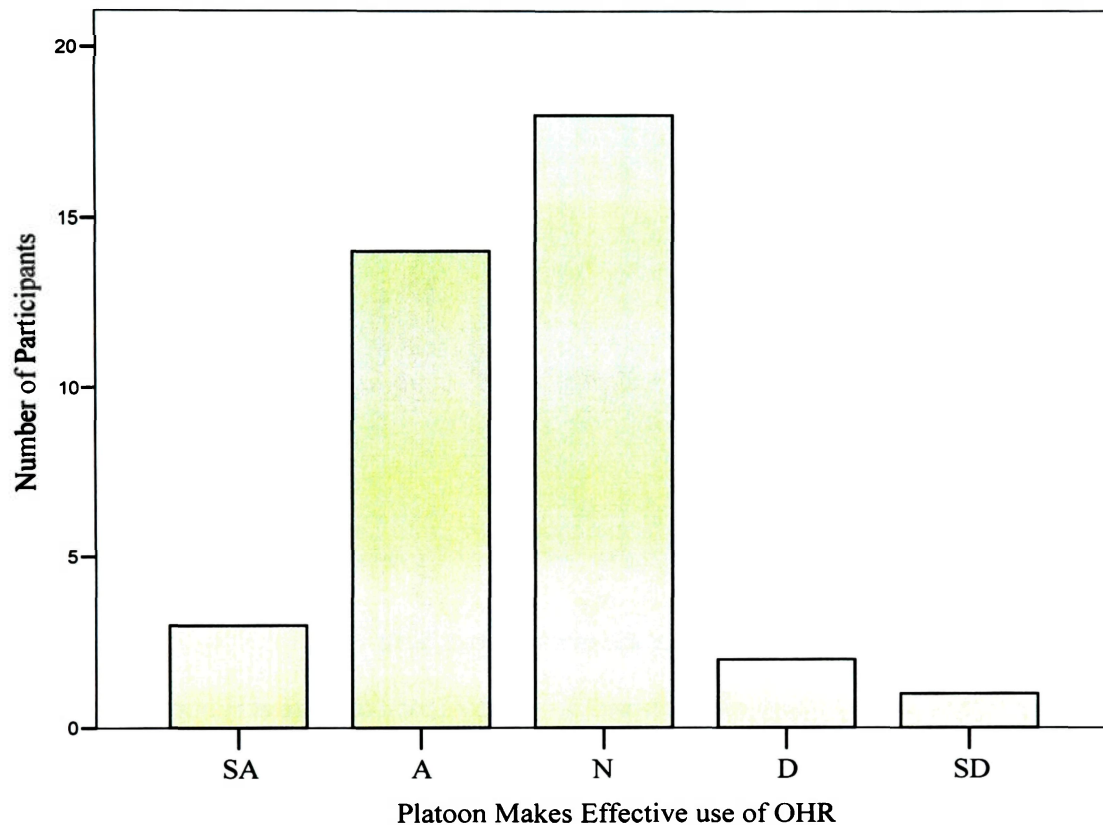


Figure 22. Participant's Platoon Makes Effective Use of OHR.

Item 23: Platoon System for Reporting Hazards, Errors, and Incidents

In addition to the regulatory OHR, many platoons developed semi-formal or non-formal reporting systems for non-accident events. Similar to the OHR, ascertaining the effectiveness of these systems was an important step in assessing the need for and implementation of a new system. Item 23 asked the respondent if their platoon had an effective system for reporting hazards, errors, and incidents. The platoon's reporting system was felt to be effective by 76.32% of participants, as indicated by their selection of SA or A. Results for this item have been depicted by Figure 23.

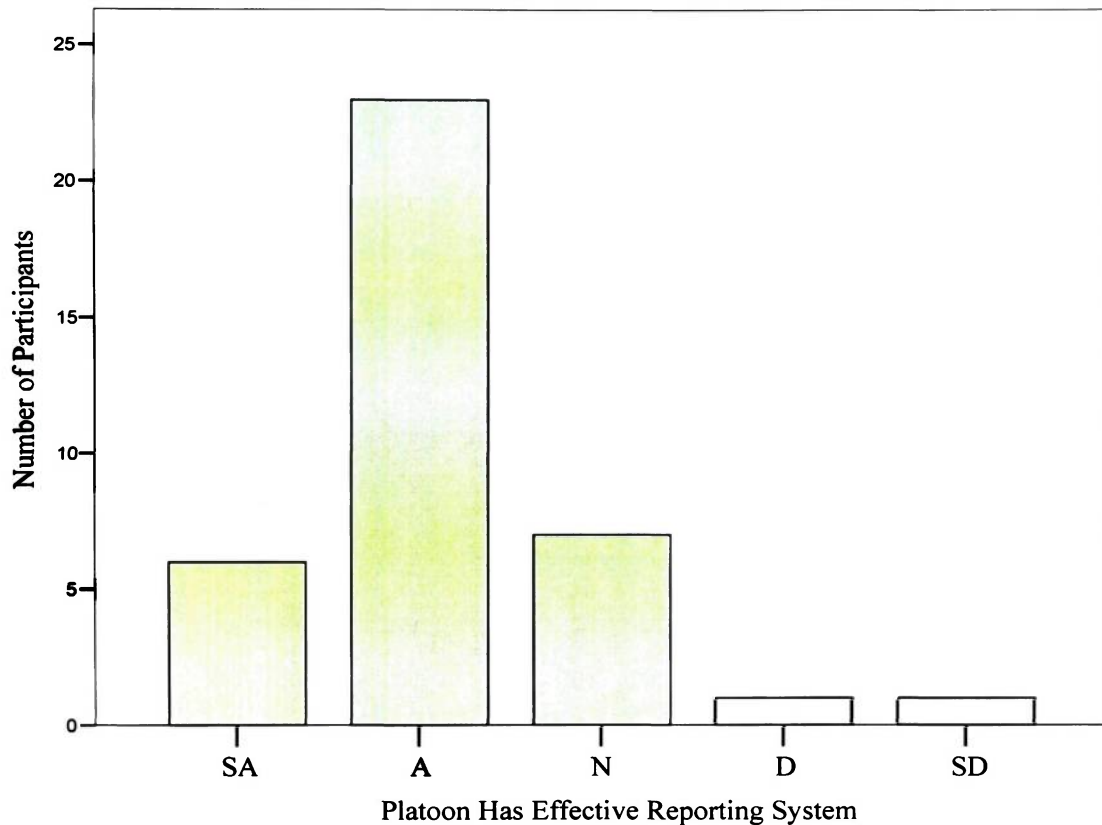


Figure 23. Platoon Has an Effective System for Reporting Hazards, Errors, and Incidents.

Item 24: Honest Mistake Reporting with No Negative Consequences

The respondents' attitudes toward a potential reporting system wherein there are no negative consequences for unintentional errors were measured by item 24. Specifically, the item asked the respondent if he would report making one of the errors listed in items 12 to 15 if he made an honest mistake and knew there would be no negative consequences. Of the respondents, 76.32% either agreed or strongly agreed that they would report making an honest mistake if they knew there would be no negative consequences. Three respondents disagreed and one strongly disagreed with the same assertion. Results for item 24 have been described by Figure 24.

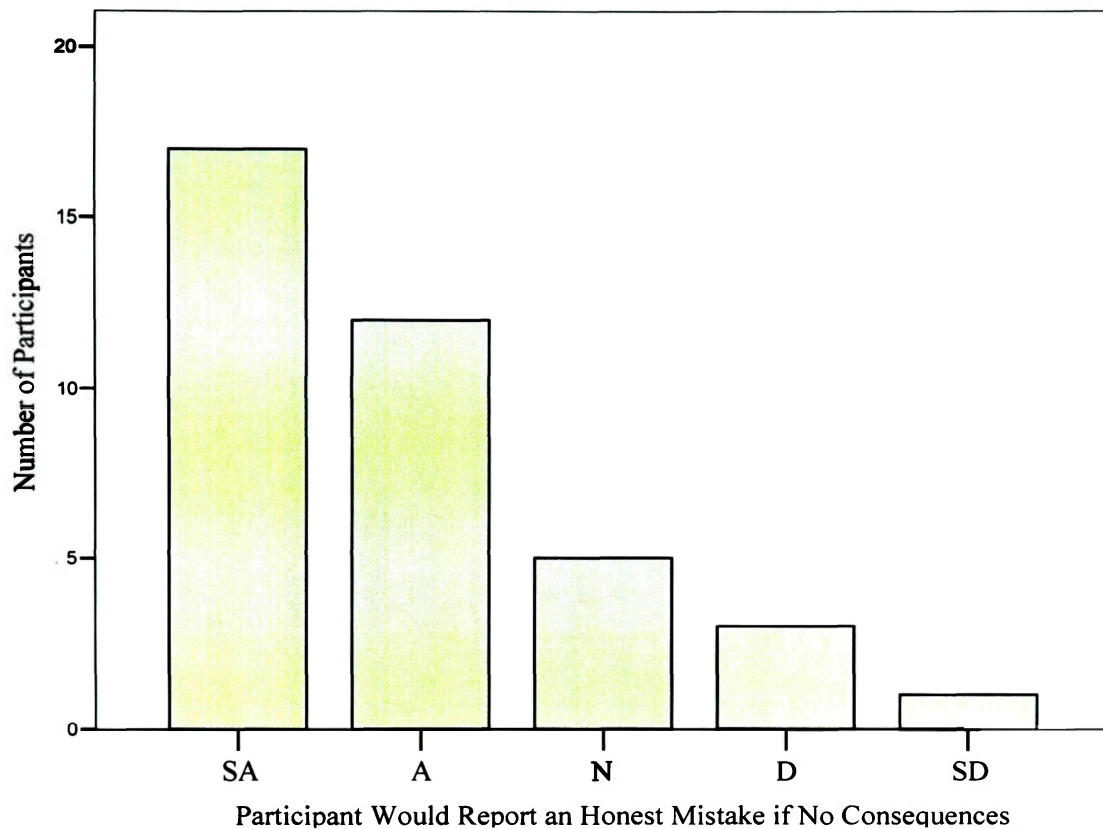


Figure 24. Participant Attitudes Regarding Reporting Honest Mistakes if There Are No Negative Consequences.

Item 25: Anonymous Reporting of Errors

Item 25 measured the respondents' attitudes regarding error reporting if the error could be reported anonymously. The phrasing of the item asked the respondent if he would report making one of the errors listed in items 12 to 15 if it could be reported completely anonymously. Of the participants, 68.42% responded that they either strongly agreed or agreed that they would report making an error if such a report could be made anonymously. Results for item 25 have been depicted by Figure 25.

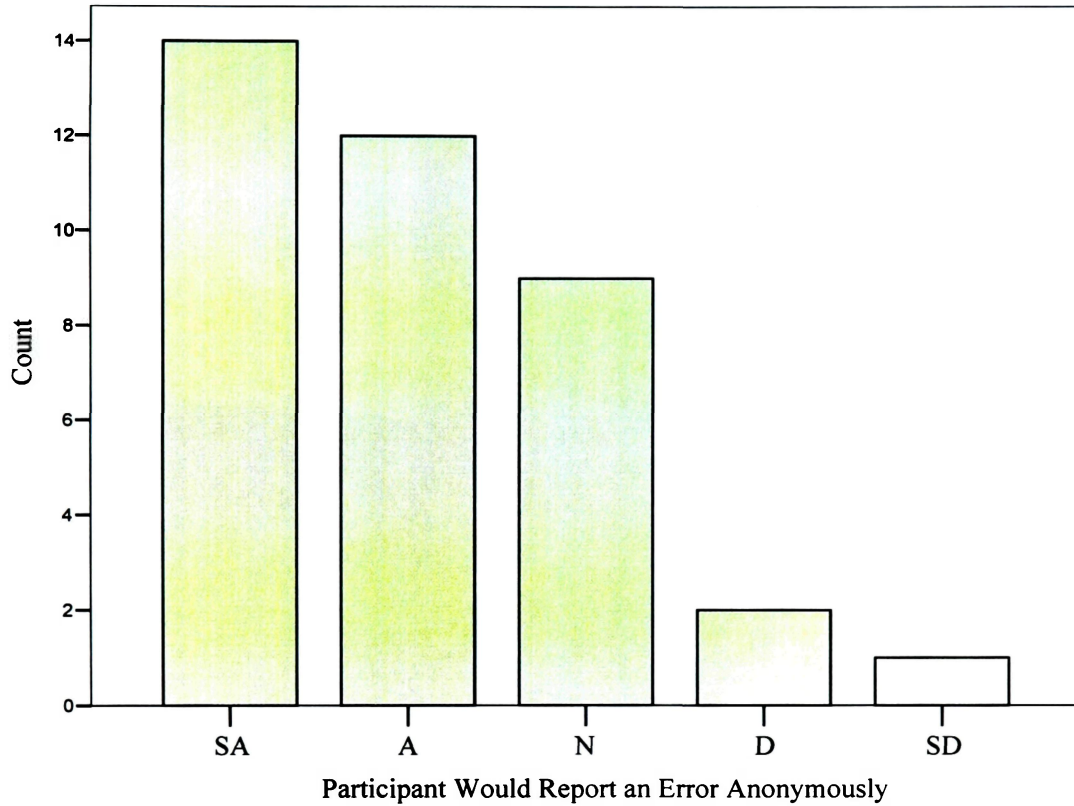


Figure 25. Participant Attitudes Regarding Reporting Errors Anonymously.

Items 26 and 27: Actions on Witnessing an Error

Items 26 and 27 determined the respondents' experiences with witnessed errors.

Item 26 asked the participant if he made one of the errors listed in items 12 to 15 and did not tell anyone. For item 26, 76.32% of participants responded that they had not made an error and failed to report it. Results for item 26 have been depicted by figure 26.

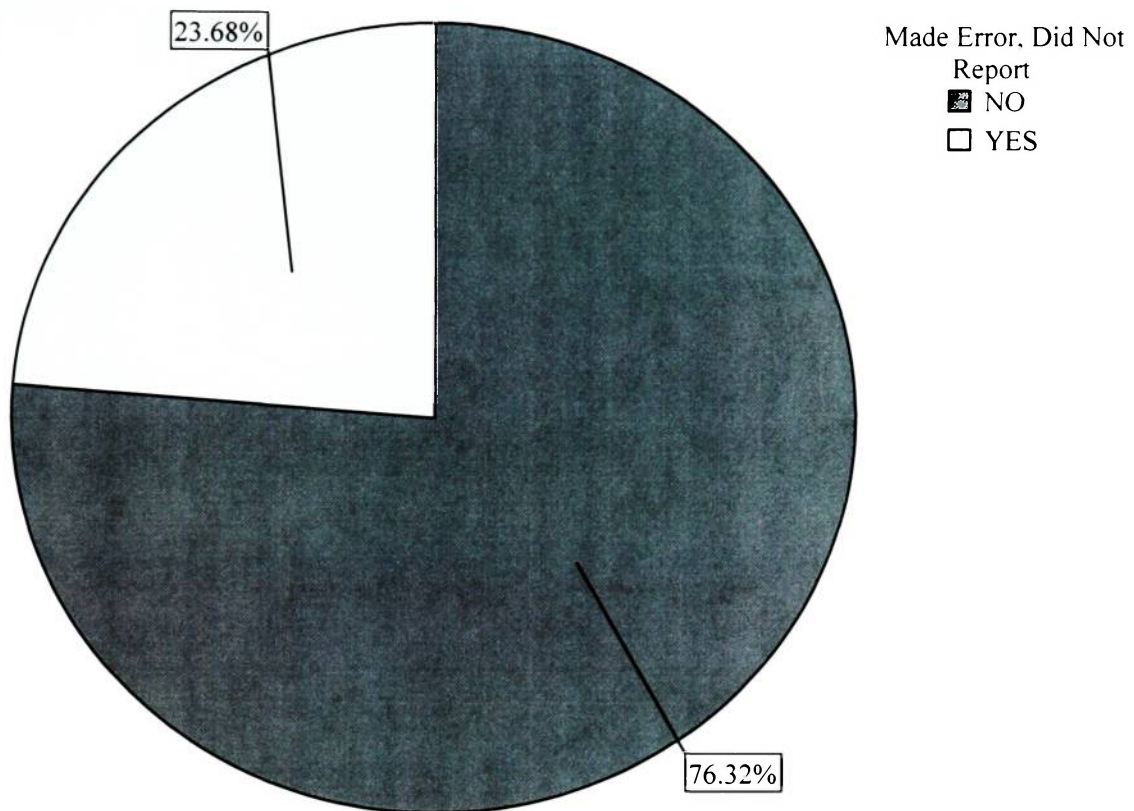


Figure 26. Participant Made an Error and Did Not Report It.

Item 27 asked the respondent if he had witnessed someone else make the same errors and did not report the error he had witnessed. For item 27, 60.53% of participants responded that they had not failed to report another's error that they had witnessed.

Results for item 27 have been depicted by Figure 27.

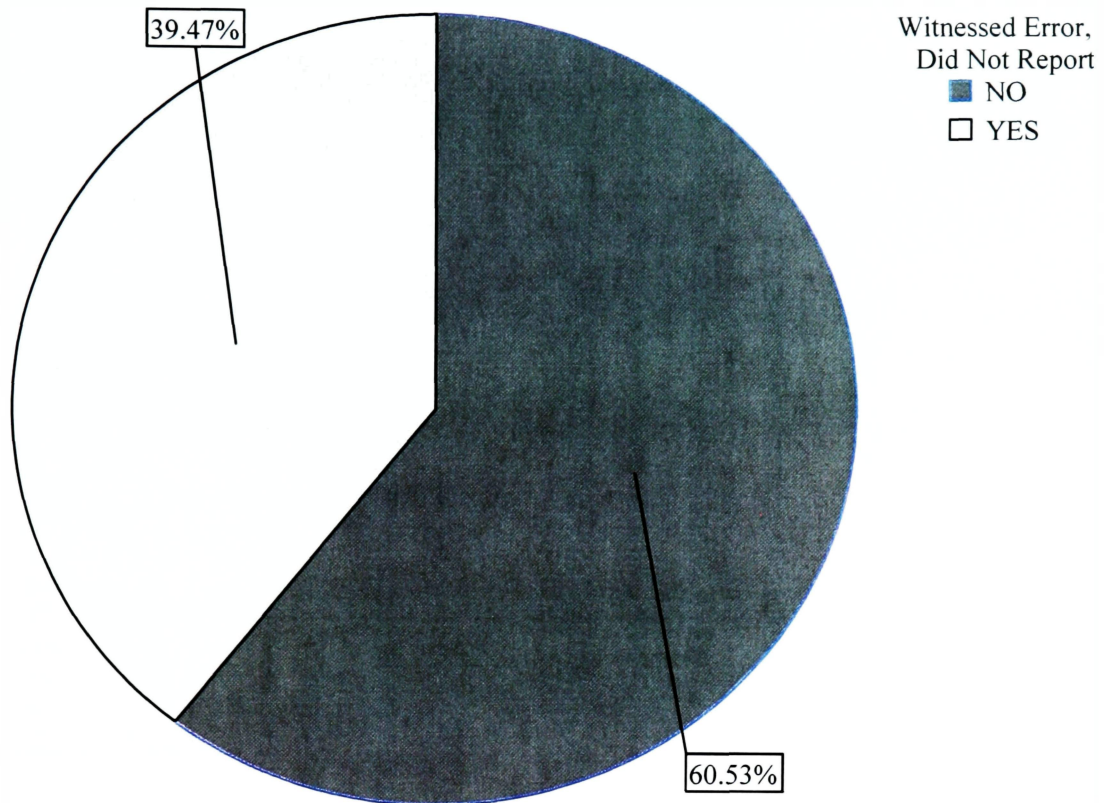


Figure 27. Participant Witnessed Another's Error and Did Not Report It.

Correlation

Items 16 through 25 were examined for correlation using r_s , chosen as the appropriate treatment for ordinal data. The use of two decimals has maintained consistency with the reporting of other statistics in the study. The correlation matrix, depicted as Table 3, has eliminated the values from above the "One Diagonal" for the variable items 16 through 25. (Negative values for the correlation coefficients have suggested an inverse relationship.)

Table 3

Correlation Matrix for Items 16 through 25

	Item 16	Item 17	Item 18	Item 19	Item 20	Item 21	Item 22	Item 23	Item 24	Item 25
Item 16	1.00									
Item 17	0.85	1.00								
Item 18	0.00	0.04	1.00							
Item 19	0.02	0.10	0.88	1.00						
Item 20	-0.31	-0.43	0.21	0.26	1.00					
Item 21	-0.46	-0.26	0.08	0.14	0.19	1.00				
Item 22	-0.40	-0.23	0.19	0.17	0.31	0.71	1.00			
Item 23	-0.26	-0.09	0.32	0.31	0.24	0.35	0.54	1.00		
Item 24	-0.51	-0.55	0.06	-0.02	0.34	0.14	0.06	0.14	1.00	
Item 25	-0.26	-0.25	-0.02	0.01	0.03	0.09	-0.18	-0.01	0.68	1.00

Qualitative Data

Responses to item 28 and the interview questions were similar in that they yielded qualitative data, as opposed to quantitative data. Item 28 asked the participant to describe any yes answers to items 26 and 27. These responses were often further explored in the follow-up interview. Results for item 28 and the interviews were too diverse to describe using techniques such as tables or charts. Some common themes occurred throughout the responses, however.

For item 28, four respondents stated that they had violated airspace or altitude clearances during emergency procedures, such as generator failures. An additional 12 respondents stated that they had either personally missed or witnessed another operator miss a checklist item; however, in none of these cases did the skipped checklist item

result in a reportable accident. Two respondents stated that they had witnessed an AVO violate airspace in the interest of supporting the MPO.

Responses to the interview questions were more diverse than those for item 28.

Nevertheless, there were some common themes that occurred during the interviews.

These common themes included perceptions that:

1. Errors were more accepted in combat situations.
2. Some errors were “no big deal” and did not warrant reporting.
3. The system would catch serious errors; in that such errors would be caught by final checks or by another operator.
4. Under the current system, errors would be met with punitive measures to include non-judicial punishment in some circumstances.

Specific responses to the interview questions have been discussed in depth in the chapters that follow.

Chapter V

DISCUSSION

The purpose of this study was to examine how voluntary and confidential reporting systems could best be implemented in Shadow 200 flight operations. As a result of research conducted in the field, 38 surveys were completed and 11 follow-up interviews were conducted. The results of the study represent the attitudes of the participants in regards to the subjects discussed in the surveys and during the interviews; specifically, confidentiality in reporting errors and the consequences of errors in Shadow 200 flight operations.

Demographics

The first 11 items determined the demographics of the participants. The specific factors measured included the participant's age and rank, readiness level as both AVO and MPO, qualification as IP, MC, SP, and CC, hours logged as AVO, MPO, MC, and CC, combat experience as a UAV operator, and graduation date from the TUAV operator's course. Data for all UAV operators was requested from the Life Cycle Manager for Army UAV operators. Only the distribution of rank for UAV operators was available. Table 4 has depicted a comparison of rank distribution between participants who recorded a rank and all UAV operators. The lone warrant officer was excluded from the list of participating enlisted men for the purpose of rank comparison.

Table 4

*Comparison of Rank Distribution between Participants and All UAV Operators
(Per C. Damboise, personal communication, April 4, 2007)*

Rank	Participants	Percentage	All Operators	Percentage
Junior Enlisted				
PVT			8	0.10
PFC	12	35.29	105	12.50
SPC/CPL	3	8.82	276	32.90
NCOs				
SGT	9	26.47	212	25.30
SSG	10	29.41	133	15.90
SFC			87	10.40
MSG			17	2.00
Total	34	100.00	838	100.00

The distribution of rank for the participants does not reflect the distribution of rank for all UAV operators. Some ranks are not represented at all in the participant population, some are overrepresented, and some are underrepresented. However, the balance of junior enlisted soldiers (i.e., Private [PVT] to SPC/CPL) and NCOs (i.e., SGT to Master Sergeant [MSG]) is similar for both groups. Junior enlisted soldiers comprise 44.11% of the participants, and 45.50% of all UAV operators, with NCOs comprising the remainder in both cases. This is the only instance in which the rank distribution of the participants resembled the rank distribution of all UAV operators.

Although no further figures were available for UAV operators from the Army, some meaningful inferences can be made from the other demographic data. The average age of participants, 25.44 years, is within one standard deviation of 28 years, the average age of a US Army Soldier (McDonald & Hertz, 2003). The distribution of age for participants also compares favorably to the Army as a whole. Table 5 depicts a comparison of age distribution between participants and all Soldiers.

Table 5

*Comparison of Age Distribution Between Participants and All Soldiers
(Data for all Soldiers from McDonald & Hertz, 2003)*

Age Range	Participants (%)	All Soldiers (%)
17 to 20	19.00	19.00
21 to 24	30.00	24.00
25 to 29	24.00	21.00
30 to 34	22.00	16.00
35 to 39	0.00	12.00
40 to 49	3.00	8.00

The distribution of age for the participants is similar, although not identical, to the distribution of age for all Soldiers. The most obvious discrepancy is in the 35 to 39 years age group, where there are no participants representing the corresponding 12% of Soldiers. Notwithstanding, visual interpretation of Table 5 suggests that the distribution of age for participants is comparable to the Army as a whole.

Items 3 and 4, concerning the participants' readiness level as AVO and MPO, found that for both positions, greater than half of the operators (55.26% and 52.63%, respectively) were the lowest readiness level, RL3. The majority of RL3 participants suggested a slightly lower level of experience than sought. Similarly, items 5 through 8 found that the majority of respondents were not qualified as IP, MC, SP, or CC—with participants responding that they were not qualified in 73.68%, 60.53%, 89.47%, and 92.11% of cases respectively.

The suggested lack of Shadow experience was offset by the results for hours logged, combat experience, and months since graduation. The *M* for AVO was 280.49 hours; the *M* for MPO was 232.38 hours. From the experience of the researcher, both of these hour amounts suggested either flight hours in combat or extensive flight time in training. Nearly half (47.37%) of participants had reported in item 10 that they had

performed UAV operator duties in combat. A closer examination of the graduation dates revealed that the participants had accumulated experience (M of 22 months) since they had graduated from the TUAV operators' course.

Research Items

Items 12 through 15 asked the participant to describe how frequently he had made a variety of errors with possible responses of never, few, and several. The items concerned violations of assigned altitude by more than 300 feet, airspace by more than 0.5 kilometers, skipped checklist items, and "any other type of error that would endanger the UAV, other aircraft, or any personnel on the ground." Of the four items, only item 14, concerning skipped checklist items, did not yield a majority of never responses. For item 14, 65.79% of respondents selected few.

Items 16 through 25 were Likert scale items, measuring the participants' attitudes toward confidentiality in reporting errors and the consequences of errors in Shadow 200 flight operations. The possible Likert scale responses were assigned numerical values from 1 to 5 for ordinal analysis, thus: SA = 1, A = 2, N = 3, D = 4, and SD = 5. This numbering enabled correlational analysis of the items utilizing r_s , which was appropriate for ordinal data (Gay, Mills, & Airasian, 2006).

SPSS software was used to generate the correlation matrix. The Likert scale items, 16 through 25, were the variables for the matrix. The researcher chose not to allow SPSS to flag significance, as textually defining relative significance has been cumbersome. Alternatively, in aviation, the criterion of a minimum correlation value of 0.3 has typically been of interest (T. R. Weitzel, personal communication, May 10, 2007).

Item 16 and five other items met the correlation criterion. However, only one item pair had a positive correlation. Positive correlation has indicated a direct relationship between the variables, whereas negative correlation has indicated an inverse relationship (SPSS, 2003). Table 6 has depicted the critical correlation of other Likert scale items with item 16.

Table 6

Critical Correlations with Item 16

Item	Relationship	Correlation Value
17	Direct	0.85
20	Inverse	-0.31
21	Inverse	-0.46
22	Inverse	-0.40
24	Inverse	-0.51

Item 16 asked the respondents if they would not tell anyone if they committed one of the errors described by items 12 through 15. A positive correlation existed with item 17, which asked a similar question, but alternatively assumed that the error was made by another operator. Negative correlations existed with items asking if:

1. The respondent's IP or SP helped operators learn from their mistakes (Item 20).
2. The respondent is familiar with the OHR (item 21).
3. The respondent's platoon makes effective use of the OHR (item 22).
4. The respondent would report making one of the errors if there were no negative consequences (item 24).

Item 17, which asked the respondent if he would report another operator's error, had an inverse relationship with two items. It had a correlation of -0.43 with item 20, which asked if the IP and SP helped learn from mistakes, and a correlation of -0.55 with

item 24, which asked if the respondent would report errors if there were no negative consequences.

Item 18 asked the respondent if there would be negative consequences if their chain of command discovered that the respondent had made one of the listed errors. Item 18 had positive correlations with items 19 and 23. Item 19 asked the same question as 18, but with the MC, IP, or SP discovering the error instead of the chain of command. The correlation between items 18 and 19 was 0.88. Item 23 asked if the respondent's platoon had an effective system for reporting errors. Item 18 had a correlation with item 23 of 0.32.

Item 19 asked if there would be negative consequences if the MC, IP, or SP discovered one of the listed errors. It had a positive correlation of 0.31 with item 23. This correlation was very similar to the correlation level of 0.32 between items 18 and 23.

Item 20 asked the respondent if the IP and/or SP helped operators to learn from their mistakes. It had positive correlations of 0.31 and 0.34 with items 22 and 24, respectively. Item 22 asked the respondent if their platoon made effective use of the OHR, and item 24 asked if the respondent would report an error if there were no negative consequences.

Item 21 asked the respondent if he was familiar with the OHR. It had positive correlations of 0.71 and 0.55 with items 22 and 23, respectively. Item 22 asked if the respondent's platoon made effective use of the OHR, and item 23 asked if there was an effective system for reporting errors.

Items 22 through 25 had few correlations that have not been discussed. Item 22 had a positive correlation of 0.54 with item 23. Item 23's correlations have been

discussed. Item 24, asking the respondent if he would report an error if there were no negative consequences, had a positive correlation of 0.68 with item 25, which asked the respondent if he would report an error if it could be reported anonymously.

Items 26 and 27 were dichotomous yes or no questions. They asked the respondent if he had either made or witnessed someone else make one of the listed errors and did not report it. For both items, the majority of respondents had not failed to disclose any observed errors. The proportion who had failed to report an observed error was higher in cases of another individual's error witnessed (39.47%) than the operator's own error going unreported (23.68%).

Qualitative Responses

Open-ended responses to item 28 asking the participant to describe any nonreported errors witnessed were varied. Four respondents stated that they had witnessed airspace or altitude violations while in a combat theatre. An additional three reported that they would not report some errors at their discretion when they were performing IP duties. In the follow-up interviews, participants further opined that some errors were "not a big deal" and could be safely ignored. One respondent stated that if there is no immediate danger in the error, it should not be reported. This was contradicted by a belief that all errors should be reported, voiced by three respondents.

Two interviewees stated that they had witnessed willful violations of flight procedures. One respondent stated that he had witnessed an operator using an inappropriate flight mode while near an airspace border, which caused the air vehicle to periodically violate airspace. The respondent believed that no cause existed for this action other than the controlling operator's laziness. The same respondent stated that the

offending operator had allowed the aircraft's strobe light to be illuminated in a tactical situation, again believing the motivation to be laziness. Another respondent stated that other operators would not follow proper procedures during in-flight handoffs of UAV control from one Ground Control Station to another. Similarly, the respondent stated that operators would fail to follow the checklist on power-up and power-down procedures, causing some of the mission-essential electronics to be damaged.

Four respondents supported the contention that errors were more easily accepted in a combat situation than in noncombat situations. One respondent stated that the presence of civilian instructors created a different culture wherein errors were considerably less tolerated. The same respondent stated that in combat the focus was on "getting the mission done." Another respondent related an incident wherein a student pilot was berated by the Air Traffic Control (ATC) authority for violating airspace. That respondent believed that ATC was much more vigilant about tracking UAV positions, and potential airspace violations, in a noncombat environment.

Current error reporting systems were perceived to frequently result in punitive actions. One respondent stated that operators would often be grounded from flight duty for a week after an incident. The same respondent also stated that the platoon's warrant officer would berate the offending operator. Another respondent stated that the IP has a duty to report the more serious errors, especially as punishment under the Uniform Code of Military Justice may result. A third respondent stated that he had witnessed a maintainer lose a qualification as a result of an error made during a between-flight turnaround inspection. A fourth respondent stated that he had witnessed an operator miss

a checklist step after having made many transfers, and that such a mistake could result in non-judicial punishment.

The results for items 21 and 22, suggesting familiarity with the OHR and the platoon's effective use of the OHR, were notably contradicted by results from interviews. Of the studied platoons, one unit had reported submitting an OHR. A respondent from that unit stated that only one OHR had been submitted that he could remember. Furthermore, the OHR had been submitted in response to an error made by another aircraft in the UAV's protected airspace. No OHRs had ever been submitted by the participants in response to an error made by a UAV operator. Respondents often perceived the OHR as a tool to "get other aviators in trouble." This is in direct contradiction to the OHR's designed purpose as an Army complement to ASRS.

The tendency of respondents to reject the temptation to not report observed errors, as defined by the results for items 16, 17, 26, and 27, were explained by results from the interviews. One participant stated that you "can't [*sic*] get away with" hiding an error, especially in a noncombat environment. Another respondent stated that "errors get found out." However, some responses contradicted the participants' negative attitudes toward hiding errors. One respondent stated that "9 out of 10 errors don't [*sic*] get reported," and inquired "Who would you tell? No one cares." The same respondent stated that there is "no established reporting procedure" and that "if there is no danger, [the error] shouldn't [*sic*] be reported." Another participant stated that there is no need to report, as the "system is self correcting." The same participant described reporting one's own error as "telling on yourself." A third interviewee stated that pride, and not wanting to lose one's reputation were reasons for not reporting errors. That interviewee also stated that the

Military Intelligence Branch culture discouraged revealing mistakes. A fourth respondent stated that errors should be reported to the IP, MC, and SP; and not to the chain of command, citing a need to avoid micromanaging and handle the problem at the lowest levels of command.

Chapter VI

CONCLUSIONS

The U.S. Army has made the elimination of accidents a priority. The negative impact of accidents has been recognized by Army leadership, and allocations have been made both in dollars and personnel towards reducing accident rates in all Army operations. The UAV accident rate has been targeted for reduction as well. Finding ways to reduce the historically high accident rate of the Shadow 200 UAV in particular has been seen as key, especially as UAV progency has transferred from Military Intelligence to Aviation.

As the Army has struggled to identify and eliminate causes of the high accident rate for the Shadow, many possibilities have been explored. Material and design deficiencies, training inadequacies, and the culture of UAV operators and maintainers have been identified and addressed by numerous efforts. Notably, operator errors have been identified as an important causal factor in Shadow accidents (Manning et al., 2004). Voluntary and confidential error reporting systems such as ASRS and ASAP in the air carrier industry have been perceived as successful in identifying and eliminating pilot errors. The purpose of this study was to examine how voluntary and confidential reporting systems could best be implemented in Shadow UAV flight operations.

This study employed a mixed methods technique, combining quantitative data obtained in a survey with qualitative data obtained in follow-up interviews to determine the attitudes of Shadow operators towards various aspects of error reporting. The

demographic data described the composition of the sample. Comparisons were made between the demographic data obtained from the study's participants with information available about the populations from which the participants were obtained. Additionally, Likert scale data from the survey were analyzed for correlation, qualitative data were examined for common themes, and survey data were compared to interview data.

The distribution of rank among the participants was not similar to that of all UAV operators. Some ranks were overrepresented while others were not represented at all. The distribution of age among participants was similar to that of all Soldiers. In age of the participants, the sample was representative of the population. The studied participants were a reasonable representation of the greater population and did represent a fair amount of experience.

Items 12 through 15 measured how many times the participant had made various errors, including airspace and altitude violations, missed checklist items, and an umbrella item for any other potentially dangerous errors. Only in the case of missed checklist items did a majority of participants select an answer other than never. This implied rarity of such errors has been contradicted in several instances by qualitative data from the follow-up interviews. Participants described an emphasis on "getting the job done" in combat situations, implying that errors were made and ignored in the interest of mission accomplishment. Similarly, every interview subject was able to describe an incident in which he had either committed an error or witnessed another's error. This discrepancy between the quantitative and qualitative data suggested a possible bias in the responses given by the participants. Specifically, knowledge of the fact that they were being studied

may have affected the responses of the participants, a phenomenon known as the Hawthorne effect (Gay et al., 2006).

In contrast to the contradictory relationship between items 12 through 15 and the interview data, the selection of checklist errors as the most common error by the participants was supported by the data obtained in the interviews. Interviewed participants made repeated references to checklist deviations both as common phenomena and as a cause for incidents and in some cases accidents. This direct relationship between the quantitative and qualitative data suggests that checklist errors are an important area for improvement.

Among the Likert scale items, several relationships meeting the minimum criterion of a correlation coefficient of 0.3 existed. The direct relationship between items 16 and 17 suggested that participants held the same attitudes towards reporting their own errors and reporting the errors of others. The inverse relationship between item 16 and item 20 suggested that operators who felt that their IPs and SPs helped them learn from their mistakes were more likely to be forthcoming in revealing their errors. Item 17's inverse relationship with item 20 suggested a similar causation to the negative correlation between items 16 and 20. This has emphasized the importance of establishing a culture among IPs and SPs wherein operators are willing to admit their mistakes and are encouraged to learn from mistakes. The inverse relationship between admitting one's own mistake and items pertaining to familiarity with and effective use of the OHR (items 21 and 22) suggested that the proper use of the OHR caused operators to be more willing to admit errors. This relationship was further highlighted by the direct relationship

between items 22 and 24. This suggested that proper implementation of the OHR has increased awareness of operator errors.

The direct relationship between items 18 and 19 suggested that negative consequences would occur regardless of whether the MC, IP, and SP discovered the error, or whether the error was discovered by the chain of command. Both items had a direct relationship with item 23, which suggested that an effective reporting system for errors meant a higher likelihood of negative consequences occurring when an error was made. This in turn has suggested that the use of error reports obtained through reporting systems should be re-examined.

The relationships existing between items 21, 22, and 23 further highlighted the relationship between OHR awareness and proper use, and effective error reporting. In addition to the previous conclusions, the importance of the OHR has been emphasized. The correlation between items 24 and 25 suggested that anonymity played as important of a role in successful error reporting as the lack of negative consequences. Although items 26 and 27 revealed that the more than half of respondents had not kept secret any errors they had made or observed, the notable percentages of respondents who had done so suggested that the reporting systems currently in place have been prompting some operators to not report errors.

Analysis of the qualitative data and comparison to the quantitative data suggested a conspicuous need for improvement in existing error-reporting systems, and provided answers to the research questions. Interview results highlighted the dismissive attitudes of many operators toward what they perceived as small or insignificant errors. Many operators expressed a desire to keep errors confidential when possible, having cited such

motivations as “solving problems at the lowest levels” or avoiding “telling on your self.” A misunderstanding of the purpose and proper implementation of the OHR was prevalent. Further, analysis suggested that proper implementation of the OHR resulted in a more healthy safety culture for the affected unit. Most disturbingly, analysis of the combined data suggested that respondents associated error reporting with negative consequences. Witnesses failed to report intentional rules violations by other operators, apparently desiring to avoid negative consequences.

Chapter VII

RECOMMENDATIONS

This study sought to determine how voluntary and confidential reporting systems, similar to those employed in air carrier operations, could best be implemented in Shadow flight operations. A mixed-methods research approach, utilizing quantitative data gathered by a survey and qualitative data gathered during interviews, was developed to answer the research questions generated in regards to this purpose. Data gathered from the 38 survey participants and 11 interview participants revealed possibilities for further research as well as important areas of concern to be addressed in the existing error reporting systems.

The determination by the researcher that field research was most appropriate, and the geographical dispersion of Shadow platoons, presented challenges in acquiring a representative sample of the population. These problems were exacerbated by the high proportion of Shadow platoons deployed in combat during the study. Due to these challenges, the study participants did not constitute a fully representative sample of the population. A lack of experience was suggested by the distribution of rank and Readiness Level as well as the proportion of advanced qualifications and combat experience. Future studies should employ a targeted sample, such as one that could be acquired using stratified sampling or purposive sampling (Gay et al., 2006) in order to obtain a more representative, experienced sample.

Deficiencies in the safety and reporting culture of Shadow platoons were discovered as a result of the study. Although a wide variety of errors were described, checklist errors were the most prevalent. The interviews further supported the notion that checklist problems were pervasive and destructive. Possible remedies for checklist-related errors have included (a) ensuring that training emphasizes proper use of the checklist, (b) enforcing checklist discipline using the chain of command and IP, SP, and MC, and (c) finding ways to make future checklists clearer, more logical, and more concise.

The OHR was identified as an area of concern. Results suggested that Shadow operators had a poor understanding of the proper use and purpose of the OHR. Instead of viewing the OHR as a useful tool and potential ally, Shadow operators viewed it as a means of identifying their own errors to the chain of command. The reluctance to use the OHR was not surprising, as results indicated that punitive actions resulting from reported errors were causing Shadow operators to not report some errors. Education about the proper use and intended purpose of the OHR has been a means of promoting a positive safety culture and ensuring that error reporting is not viewed as a cause of negative consequences.

Further research is needed into implementing the aforementioned recommendations. It is possible that the existing OHR system could be used as an effective means of allowing Shadow operators to report errors with some degree of confidentiality. The effectiveness of the OHR is another subject for further inquiry. However, should the OHR prove inadequate for addressing the needs of the Shadow community, a new reporting system may be required. As the OHR has been centralized in

its reporting structure, a localized, responsive system (similar to ASAP) may prove necessary.

Culture was relevant when comparing the experiences of operators, and deficiencies in culture constituted an important theme in the interview data. The researcher found from studying individual platoons that the safety culture of each platoon was different, as manifested by the attitudes of participants. Cultural differences were evidenced by factors such as attitudes toward error reporting and differing levels of trust in the IPs or SPs. Shadow platoons have tended to be insular and have experienced little interaction with other platoons. This has been dissimilar from traditional practice in manned Aviation units, wherein standardization pilots and standardization programs have existed at all levels between the Company level (encompassing tens of pilots) and the Brigade level (encompassing hundreds). An emphasis on standardization, to include designating personnel as standardization pilots for multiple platoons, has encouraged different platoons to meet the same standards, and has assisted in promoting a positive safety culture. Wide-spread standardization has been a key aspect of Aviation operations and an increased emphasis on standardization would be an appropriate addition as the Shadow passes into Aviation advocacy.

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APPENDIXES

APPENDIX A
The Survey Instrument

Demographic Information

1. Age : _____

2. Rank: _____

(Please circle the appropriate answer)

3. What is your current *AVO* Readiness Level? RL1 RL2 RL3 Unsure4. What is your current *MPO* Readiness Level? RL1 RL2 RL3 Unsure

5. Are you Instructor Pilot qualified? Yes No

6. Are you Mission Commander qualified? Yes No

7. Are you the platoon Standardization Pilot? Yes No

8. Are you Crew Chief qualified? Yes No

9. Approximately how many hours have you logged in the following positions:

AVO: _____ *MPO*: _____ *MC*: _____ *CC*: _____

10. Have you performed UAV Operator duties in a combat theatre? Yes No

11. When did you graduate from the TUAV Operator's course at Ft. Huachuca (Day, Month, Year)?

Study Questions

12. How many times have you ever accidentally flown outside of your assigned altitude by more than 300 feet? Several Few Never

13. How many times have you ever accidentally flown outside of your assigned airspace by more than 0.5 km? Several Few Never

14. How many times have you ever accidentally skipped a checklist item? Several Few Never

15. How many times have you ever made any other type of error that would endanger the UAV, other aircraft, or any personnel on the ground? (Feel free to describe the incidents on the back). Several Few Never

16. If I made one of the errors listed in questions 12 - 15 and no one else saw it happen, I would not tell anyone.

Strongly Agree Agree Neither Agree or Disagree Disagree Strongly Disagree

17. If I saw **another operator** make one of the errors listed in questions 12 - 15 and no one else saw it happen, I would cover for him/her and not tell anyone.

Strongly Agree Agree Neither Agree or Disagree Disagree Strongly Disagree

18. If my **chain of command (Squad Leader, PSG, PL, etc)** found out that I made one of the errors listed in questions 12 – 15, there would be negative consequences.

Strongly Agree Agree Neither Agree or Disagree Disagree Strongly Disagree

19. If a **Mission Commander, Instructor Pilot, or the Standardization Pilot** found out that I made one of the errors listed in questions 12 – 15, there would be negative consequences.

Strongly Agree Agree Neither Agree or Disagree Disagree Strongly Disagree

20. Our **Instructor Pilot and/or Standardization Pilot** helps us learn from our mistakes.

Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
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21. I am familiar with the Occupational Hazard Report.

Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
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22. My platoon makes effective use of the Occupational Hazard Report.

Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
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23. My platoon has an effective system for reporting hazards, errors, and incidents.

Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
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24. If I made an honest mistake and I knew there would be no negative consequences, I would report making one of the errors listed in questions 12-15.

Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
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25. I would report making one of the errors listed in questions 12-15 if I could report it completely anonymously.

Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
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26. Have you ever made one of the errors listed in questions 12-15 and didn't tell anyone?

Yes	No
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27. Have you ever seen someone else make one of the errors listed in questions 12-15 and didn't tell anyone?

Yes	No
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28. If you answered "yes" to question 26 or question 27, please describe what happened below. If necessary, continue on the back.

APPENDIX B

The Interview Questions

INTERVIEW QUESTIONS

1. Please describe a situation in which you either committed an operator error or observed another operator commit an error and didn't tell anyone.
2. Why didn't you tell anyone about the error?
3. Has anyone in your platoon been punished for committing an error?
4. What was the nature of their error? In other words, what caused them to make that mistake?
5. How did the chain of command and/or the instructor pilots react when they found out about the error?
6. What training resulted from the error being discovered?
7. If a system existed to anonymously report errors committed, would you use it?
8. If you could report your errors without fear of punishment, would you do so?
9. What would be the positives and negatives of a system for anonymously reporting errors?
10. What would be the positives and negatives of allowing operators to report errors without fear of punishment?

APPENDIX C

Participant Cover Letter

Spring 2007

During the next hour, you have the opportunity to participate in a study to determine the need for a voluntary and confidential system for reporting errors in Shadow UAV flight operations. This study is being conducted as part of a graduate thesis. Your participation is voluntary and greatly appreciated. All information and data obtained will be kept confidential. The identity of participants will never be revealed, and all data gathered will be only be used in this study, and will not be available to anyone else. This study is in no way affiliated with the United States Army or the Department of Defense.

As your facilitator and researcher, I will provide detailed guidance and answer questions that arise throughout the administration of the survey. Upon completion of the survey, some participants will be asked to participate in an interview. This interview, like the survey, is strictly voluntary. Please answer any and all questions to the best of your ability.

Thank you for your cooperation. If you have questions or concerns regarding this study, you may contact me via e-mail (billjagnow@hotmail.com). As with the information and data obtained in the study, any correspondence will be confidential.

Sincerely,

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