PUBLIC SECTOR PILOT PERCEPTIONS OF FLIGHT OPERATIONAL QUALITY ASSURANCE PROGRAMS

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Title of Study: Public Sector Pilot Perceptions of Flight Operational Quality Assurance Programs

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Abstract: A Flight Operational Quality Assurance (FOQA) program monitors pilots by storing hundreds of flight parameters i.e. speed, altitude, instrument readings etc. retrievable for playback. Thus, FOQA is a powerful aviation safety tool, but FOQA has also raised critical data-protection issues regarding its use for disciplinary or FAA actions, and/or release to outside entities for civil or criminal litigation.

The FAA has a strong desire to expand FOQA, however only 17% of smaller air operators have voluntarily adopted it, and little is known about pilot perceptions of FOQA. Technology improvements and cost reductions have enabled its adoption. The General Accountability Office has maintained negative pilot perceptions are a barrier to further adoption of FOQA.

This is the first comparative research to study pilot perceptions of FOQA. This research hypothesized that public sector pilots flying under a FOQA program would have more positive perceptions, and lower negative perceptions of FOQA than their counterparts not flying under a FOQA program. No significant differences were found on either the positive perceptions scale, $t(185) = .24$, $p=.81$, or the negative perceptions scale $t(185)= 1.56$, $p=.12$. A one-way ANOVA indicated that education level did not have a significant relationship with either positive, $F(3.178) = .69$, $p=.56$, or negative, $F(3.179) = 1.04$, $p=.38$, perceptions of FOQA.

It was hypothesized that pilots with FOQA experience would have higher positive perception scale scores, and lower negative perception scale scores, than pilots operating without FOQA experience. The one-tailed point-biserial correlation indicated that there was no significant relationship between positive, $r_{pb}(142) = .09$, $p= .14$, or negative $r_{pb}(142) = -.16$, $p= .03$, perceptions with FOQA experience.

Public sector small air operators operate in a variety of environments that pose risk to safe operations. FAA's promotion of safety data analysis by air operators through voluntary adoption of FOQA has stalled. If FAA desires to retain global leadership in flight data analysis and safety risk management, they should initiate new action to reenergize broader adoption of FOQA including the protection of sensitive safety information from litigation discovery, and the reevaluation of FOQA as a voluntary safety program.

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INTRODUCTION

Electronic Monitoring of Employees

Managerial tools to electronically monitor employee's performance have exploded over the past 25 years as has employee use of technology to perform routine work. The ability of employers and other interested parties to track individual behavior has rapidly expanded through the use of the personal computer, the internet, cellular phones and the Blackberry which have all been integrated with the global positioning system (GPS). The National Association of Working Women reported in 1984 that some 20% of clerical employees were monitored by computer (Grant & Higgins, 1987). Three years later, The Office of Technology estimated that six million workers were being electronically monitored (U.S. Congress Office of Technology Assessment, 1987). By 2001, the American Management Association reported that 82% of the managers surveyed used some type of electronic monitoring system to ascertain employee performance (Papini, 2007), and electronic tracking and monitoring has continued to grow throughout the first decade of the 21st Century enabling increases in organizational productivity, but also creating employee concerns about the privacy, use, access, and potential abuse of electronic monitoring systems and the data they produce.

FOQA Data Analysis for Safety

Electronic monitoring of a pilot's performance is possible through the use of a Flight Data Analysis (FDA) program or Flight Operational Quality Assurance (FOQA) program (FDA is used internationally and FOQA is the term used in the United States). FOQA programs obtain and analyze flight data about a pilot's performance. Digital quick access data recorders (QAR's) on board modern aircraft store hundreds of parameters about the flight such as: aircraft speed, altitude, instrument readings, power lever and switch positions (Lacagnina & Rosenkrans, 2004). This information can be retrieved after landing, or transmitted directly to the ground, for downloading into software enabling the flight to be *recreated* and replayed for further review and evaluation.

"Federal aircraft programs operate and maintain aircraft that are engaged in some of the most dangerous types of flight possible. For example, United States Department of Agriculture (USDA) Forest Service pilots often fly 150 feet above the ground level at roughly 175 miles per hour when dropping fire retardant in an effort to suppress forest fires" (U.S. Government Accountability Office, 2004, p. 29). FAA flight inspection aircraft also are operated at tree top level at high speeds to assure the integrity of ground navigational signals used to vertically and laterally guide aircraft to the runway in poor weather conditions. Thus, this specialized federal segment of the aviation industry could benefit significantly by voluntarily adopting FOQA as a component of their overall safety management system. FAA's newly proposed Safety Management System (SMS) regulations will require air operators to analyze their organizational risks and maintain processes and systems to acquire data. FOQA could play a significant part of an air operator's safety management system; however FAA does not propose to make FOQA mandatory for any U.S. air operators.

FOQA programs have provided one of the most powerful tools available to aviation safety, but electronic pilot monitoring using FOQA has also raised critical data-protection issues and pilot concerns about its use for disciplinary or FAA regulatory actions, and/or release of FOQA data to outside entities for civil or criminal litigation. FOQA can become an important integrated component of an air operator's safety management system; however pilot perceptions of FOQA may be precluding its wider adoption throughout the aviation industry.

Problem

The FAA has a strong desire to expand the use of FOQA as a voluntary safety reporting tool which is dependent to a certain degree on pilot acceptance (Federal Aviation Administration, 2010), but relatively little is known about pilot perceptions of being electronically monitored by FOQA. Technology improvements and cost reductions in equipment over the past 15 years have enabled adoption of FOQA by small air operators (Lacagnina, 2007; U.S. Government Accountability Office, 2010). Small air operators have higher safety risk factors and higher accident rates; however only 17% of smaller air carriers have voluntarily adopted FOQA. In addition, only one federal air operator (FAA's flight inspection organization) has chosen to adopt FOQA even though small air operators have higher safety risk factors and higher accident rates than larger air operators (*The Federal Aviation Administration's Oversight*…, 2010; Von Thaden & Wiegmann, 2011; Federal Aviation Administration, 2011). The National Transportation Safety Board (NTSB) has recommended that the Federal Aviation Administration require small air operators to adopt flight data analysis or FOQA programs (U.S. National Transportation Safety Board, 2009). The U.S. Government Accountability Office (GAO) has maintained that the

reluctance of small air operators to voluntarily adopt FOQA can be attributed, in part, to negative pilot perceptions of FOQA (U.S. Government Accountability Office, 1997, 2010); however research has not been conducted on pilot perceptions of FOQA, and there is currently little understanding of pilot perceptions of FQOA based upon empirical evidence.

Understanding pilot perceptions of FOQA (both positive and negative) could enhance aviation safety by leading to an increased understanding of pilot concerns and thereby mitigate some of the perceived barriers to expanding FOQA to small air operators. In addition, this research could contribute to the development of mitigation strategies that might minimize negative pilot perceptions of being electronically monitored by FOQA.

Purpose

The purpose of this research was to describe and compare public sector pilot perceptions of FOQA. This research compared the positive and negative perceptions of pilots operating for federal public sector air operators operating under a FOQA program, with those pilots operating without one. Understanding pilot perceptions about FOQA should enhance aviation industry knowledge about pilot hopes and perceived benefits of FOQA, as well as their fears and concerns of electronic monitoring, thereby enabling the mitigation of the perceived barriers that have precluded FOQA's expansion throughout the small air operator sector of the aviation industry.

Significance of the Study

The FAA states that their most important job is to protect the safety of the traveling public through ensuring that all air operators provide effective high quality safety programs (Federal Aviation Administration, 2010a). FOQA programs have enabled the routine gathering of flight data providing objective evidence of the effectiveness of air operator safety programs and training programs in large air carrier airline operations. On the other hand, despite significant advancements in technology and equipment cost reductions in recent years, small air operators have not voluntarily adopted one of the most powerful tools available to the airlines (Pfleiderer & Chidester, 2011). The FAA's senior official responsible for aviation safety acknowledged during Congressional testimony in 2010 that the accident rate for small air operators (on-demand Part 135) was higher than that for large scheduled airlines, but the FAA anticipated all operators would receive the same type of *data driven surveillance* (italics added) in the future under FAA's new Safety Assurance System known as SAS (*FAA's oversight of on-demand aircraft operations,* 2010). Thus, small air operators and the FAA would benefit if small operators voluntarily adopted FOQA and data was available. In addition, small public sector air operators operating in high risk environments could better understand their level of safety and be able to focus upon risk mitigation strategies by voluntarily adopting and using FOQA to identify adverse safety trends that could lead to incidents or accidents. In addition, adoption of FOQA beyond the Federal Aviation Administration flight program into the broader federal public sector flight programs would set an example for the private sector small air operator community. Acceptance of FOQA by pilots requires an understanding of pilot perceptions (both positive and negative) of FOQA in order for air operators to develop strategies to successfully promote its voluntary adoption. This comparative study is the first research directed at understanding the differences in

pilot perceptions between those pilots operating under a FOQA program (FAA sample), with those operating without one (GSA sample). The survey instrument (PFOQA) was co-authored by Dr. Thomas R. Chidester, Manager of the FAA Aerospace Human Factors Research Division, and this researcher to elicit pilots' level of agreement with a series of 16 statements about FOQA (Pfleiderer & Chidester, 2011; Lowe, Pfleiderer & Chidester, 2012).

Limitations of the Study

This study was limited to a comparison of federal public sector pilots employed by small air operators in the federal public sector consisting of a total population of 396 pilots. The researcher assumed pilots understood the survey and responded in a truthful manner on the PFOQA survey. The FAA sample (188 pilots) had a 56% response rate; however the GSA sample (208 pilots) had a 46% response rate. Generally, a response rate of at least 50 percent is considered adequate for analysis and reporting (Barbbie, 1990, p. 182). Thus, the GSA response rate was slightly lower than generally required and may have compromised external validity of the study's findings beyond the sample. In addition, the researcher was unable to obtain a true random sample of the pilot population because anonymity was required in order to obtain pilot responses to the survey.

"The Principal Components Analysis of the PFOQA survey instrument suggested the need for further augmentation of the PFOQA survey items because only 60% of the variance in the dataset was explained by the extracted components, leaving 40% unexplained" (Pfleiderer & Chidester, 2011, p. 9). Also, according to Pfleiderer and Chidester (2011), the PFOQA questionnaire would benefit from the inclusion of additional items (Pfleiderer & Chidester, 2011,

p. 10). Finally, surveys of private sector pilot perceptions may or may not be similar to those obtained during this research of public sector pilot perceptions of FOQA.

Theoretical Perspective

This study was designed to investigate and understand pilot perceptions of Flight Operational Quality Assurance programs in federal public sector flight operations. Thus, the study involves explaining dynamic social phenomena subject to continuous change. This study embraces the Post-Positivism perspective which attempts to find if differences exist and determine the best explanation for the differences if they exist. This research also recognizes that knowledge and perceptions can and do change over time, and thus the research may contribute to the development of potential mitigation strategies that can overcome negative perceptions of being electronically monitored through a Flight Quality Assurance Program.

Aviation safety has improved significantly over the past 50 years due to advancements in technology, equipment, operating procedures and training practices (Weigmann & Shappell, 2003). This research focuses on the psychosocial perspective of aviation human factors. "Historically, the psychosocial models have been overlooked by those in the aviation industry (Weigmann & Shappell, 2003, p. 35). Understanding individual pilot perceptions of the potential safety benefits of FOQA is important in order to develop an understanding of the human interpersonal relationships that can be critical to safe aircraft operation.

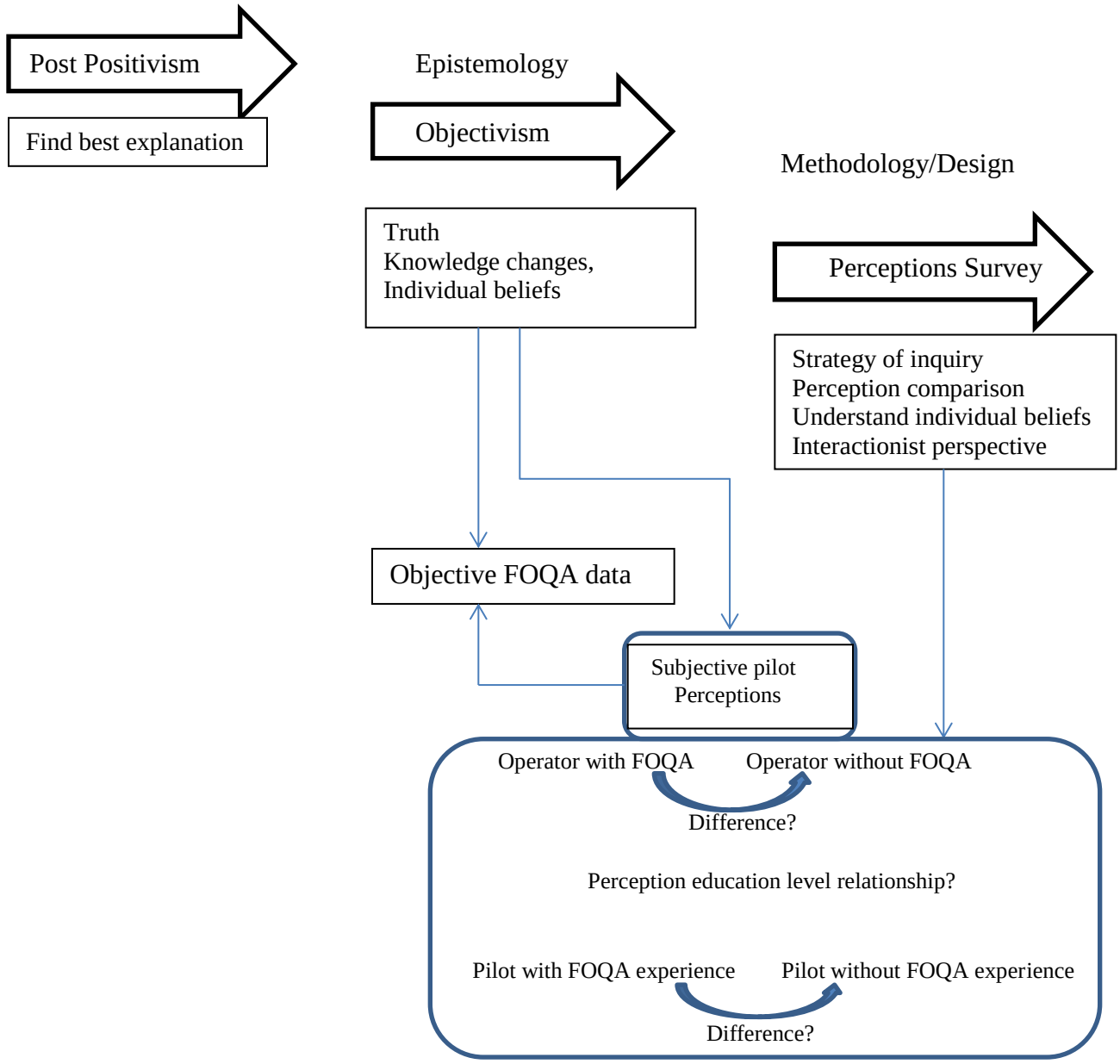


Figure 1: Theoretical perspective

Research Questions

1) Do FAA pilots flying under a FOQA program in the public sector have more positive perceptions of FOQA than their counterparts not flying under a FOQA program?

   Null Hypothesis: There will be no significant difference between the positive perceptions of federal public sector pilots flying with a FOQA program and their counterparts not flying under a FOQA program.

2) Do pilots flying without a FOQA program have more negative perceptions than their counterparts flying with a FOQA program?

   Null Hypothesis: There will be no significant difference between the negative perceptions of federal public sector pilots flying without a FOQA program and their counterparts flying with a program.

3) Is there a relationship between education levels and perceptions of FOQA?

   Null Hypothesis: There will be no relationship between federal public sector pilot education levels and positive or negative perceptions of FOQA.

4) Is there a relationship between positive perceptions of FOQA and the amount of time spent in a FOQA program?

   Null Hypothesis: There will be no relationship between positive public sector pilot perceptions of FOQA and the amount of time spent in a FOQA program.

5) Is there a relationship between negative perceptions of FOQA and the amount of time spent in a FOQA program?

   Null Hypothesis: There will be no relationship between negative public sector pilot perceptions of FOQA and the amount of time spent in a FOQA program.

Table 1.

Listing of Acronyms Used in the Study

ALPA	Airline Pilots Association
AJW	FAA Aviation System Standards internal routing symbol
AMOA	Air Medical Operators Association
ARAC	Aviation Rulemaking Advisory Committee
ASAP	Aviation Safety Action Program
CAMI	Civil Aerospace Medical Institute
CFR	Code of Federal Regulations
DOT	Department of Transportation
DFDAU	Digital Flight Data Acquisition Unit
ECS	Electronic Control System
EPM	Electronic Performance Monitoring
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FDA	Flight Data Analysis
FDR	Flight Data Recorder
FSF	Flight Safety Foundation
FOIA	Freedom of Information Act
FOQA	Flight Operational Quality Assurance Program
GAO	Government Accountability Office
GPS	Global Positioning System
GSA	General Services Administration
HAI	Helicopter Association International

ICAO	International Civil Aviation Organization
IRB	Institutional Review Board
NASA	National Aeronautics and Space Administration
NSF	National Science Foundation
NTSB	National Transportation Safety Board
OTA	Office of Technology Assessment
OIG	Office of Inspector General
PFOQA	Perceptions of Flight Operational Quality Assurance questionnaire
QAR	Quick Access Recorder
SARP	Standard and Recommended Practice
SAS	Safety Assurance System
SMS	Safety Management System
USDA	United States Department of Agriculture
USC	United States Code

CHAPTER II

REVIEW OF THE LITERATURE

The objective of this literature review was to provide an overview of the current knowledge and research regarding the background, history and safety benefits of Flight Operational Quality Assurance (FOQA) programs, as well as the individual and organizational issues associated with electronic monitoring of employees. FOQA can become an important integrated component of an air operator's safety management system; however pilot perceptions of FOQA may be precluding its wider adoption throughout the broader aviation industry. In sum, management in many industry sectors has continued to embrace electronic employee monitoring, and the number and types of employees electronically monitored has rapidly expanded as the technology has evolved; however privacy issues, concerns about management abuse and release of electronic data to outside entities has also grown.

History of Electronic Monitoring

Monitoring employees is not new. Since the early days when labor was organized around common tasks, the monitoring of individual and organizational output became a supervisory and managerial responsibility. The rise of computer technology in the 1980's and 90's opened new

avenues for managers and supervisors to electronically monitor employee behavior and productivity. Susser (1988) reported that electronic monitoring was generally used for three purposes: measuring performance, preventing internal theft, and enforcing laws and workplace rules (Susser, 1988).

Today, personal computers, the internet, cell phones and computing tablets have all become a part of daily life. These sophisticated and integrated tools have rapidly become common throughout many industries and continued to enhance management's ability to digitally track individual activities. Management can effectively plan and monitor workload distribution and assess the quality of an individual's performance. Management can also store large amounts of electronic performance data raising privacy and fairness issues, as well as debates about the proper amount of social monitoring and control of employees in our free society.

Over two decades ago the U.S. Congress Office of Technology Assessment (OTA) attempted to discriminate *computer based monitoring* or *electronic monitoring*, from the more traditional *service observation*, or practice of listening to an employee's conversation during an economic transaction (U.S. Congress Office of Technology Assessment, 1987). The OTA foresaw questions of fairness, dignity, autonomy and control as growing issues associated with the anticipated widespread availability of new technologies. The report noted the potential for employee resistance and resentment due to perceptions of unfair implementation and/or data misuse by management and/or outside organizations (U.S. Congress Office of Technology Assessment, 1987). Electronic monitoring capabilities have continued to expand since OTAs' 1987 report. Cell phones are routinely equipped with GPS location services making everyone's actions more visible for marketing, and for use in the new field of technology forensics – a technique used by prosecutors in over 250 criminal cases (Kaste, 2009). Thus, electronic

monitoring technology is a widely available and increasingly cost effective option for tracking individual activities in many industries.

History of FOQA

"FOQA programs evolved from accident investigation practices using Flight Data Recorders (FDRs), which were mandated in 1958 by the Civil Aeronautics Administration" (Lowe et al., 2012, p. 1). Early flight data recorders had limited monitoring capabilities capturing only six parameters (time, airspeed, heading, altitude, vertical acceleration and time of radio transmission); however they were useful for post-accident analysis enabling federal regulators and aviation safety professionals to conduct forensic studies to understand and improve operational and maintenance safety. The use of flight data recorders for non-accident routine data collection did not begin in the United States, but began with British Airways and Air Portugal in the early 1960's (Lacagnina & Rosenkrans, 2004). TWA was the first U.S. air carrier to begin a flight data analysis (FDA) program in the late 1960's, but the program was limited to a few monitored parameters related to the pilots approach and landing performance (Lacagnina & Rosenkrans, 1998)**.** By 1972 eight foreign airlines had adopted some type of flight data analysis program, but the U.S. continued to lag behind with only four U.S. airlines (United, US Airways, Continental and Alaska Airlines) adopting a program by the early 1990's (U.S. Government Accountability Office, 1997).

The FAA contracted with the Flight Safety Foundation in 1991 to work with representatives of the air carrier industry to complete a report on the potential benefits of flight data analysis. The 1992 report coined the term *Flight Operational Quality Assurance* (FOQA) and defined it as "a program for obtaining and analyzing data recorded in flight to improve flight

crew performance, air carrier training programs and operating procedures, air traffic control procedures, airport maintenance and design, and aircraft operations and design" (Flight Safety Foundation, 1992. p. 1). The report also stated that the appropriate use of FOQA data by airlines and other industry groups would result in the significant improvement of flight safety by identifying operational irregularities that could foreshadow accidents and incidents (Pfleiderer & Chidester, 2011) The report recommended that FAA move forward in promoting voluntary adoption of FOQA by large air operators, and the report also stated that smaller jet and propeller aircraft could also benefit by adopting FOQA (Flight Safety Foundation, 1992). Finally, the study concluded that implementation of FOQA programs across the aviation industry could have a more positive impact on aviation safety than any other human factors program, and thus the FAA should be a strong advocate for its implementation (Pfleiderer & Chidester, 2011).

The Department of Transportation and the Federal Aviation Administration convened a safety conference in Washington, D.C. in January 1995 to focus on ways to improve aviation safety and increase public confidence in air transportation. FAA Administrator David Hinson, and Department of Transportation Secretary Frederico Pena actively promoted the safety benefits of FOQA during this national safety summit attended by over 1000 airline and union aviation officials (Federal Aviation Administration, 1995) following a year of tragic air carrier accidents in 1994 (Wald, 1995). At the conclusion of the conference, the Airline Pilots Association (ALPA) agreed to end their long opposition to FOQA because of fears it would be used against individual pilots (Phillips, 1995). Subsequently, FAA's Director of Flights Standards, Mr. Thomas Accardi, began a $5.5 million FOQA demonstration project to facilitate the start-up of a cadre of large U.S. airline FOQA programs with the goal of assessing the costs, benefits and safety enhancements associated with broader implementation of FOQA throughout the United

States (Flight Safety Foundation, 1998). This FOQA Demonstration Project, known as Demoproj, was generally successful in promoting the implementation of voluntary FOQA programs at large air operators (U.S. Government Accountability Office, 1997). The Government Accountability Office (GAO) reported that the initiative established collaborative partnerships between the FAA and interested airlines (U.S. Government Accountability Office, 1997). By the end of the decade, the number of large air carriers initiating FOQA had doubled in the U.S. (Fernandes, 2002). By 2010, the GAO stated the majority of large air carrier flights were operated under a FOQA program, but only 17% of the smaller air carriers had adopted FOQA (U.S. Government Accountability Office, 2010).

FOQA's Safety Benefits

FOQA programs change behavior through improved shared knowledge. According to the behavior-based theory of accident prevention, improving people's behavior has a major influence on accident frequency (Whittingham, 2008). Aircraft safety and air traffic performance has been improved in air carriers that have implemented FOQA programs, and the data analysis has also improved FAA's air traffic procedures. For example, FOQA data have objectively established when pilots were flying high speed approaches contrary to safe operating procedures and/or the airline's approved operations manual (Lacagnina & Rosenkrans, 1998). FOQA has also revealed pilots over rotating (raising the aircraft's nose too high during takeoff) which can result in the aircraft's tail striking the ground. Identification of this situation has enabled training improvements before a tail strike occurred (Lacagnina & Rosenkrans, 2004).

The examination of another airline's FOQA data revealed several instances of unstabilized approaches where pilots exceeded the maximum flap and landing gear speeds during an approach to landing. In this interesting case, the airline voluntarily shared their FOQA data with other airlines and the FAA which revealed a problem with FAA's air traffic procedures at the airport. Specifically, air traffic controllers were placing pilots in the difficult position of being kept high and fast close to the airport resulting in pilots attempting to reduce altitude and slow down simultaneously (Federal Aviation Administration, *n.d.*). This resulted in the aircraft exceeding landing gear and flap operating speed limits (Federal Aviation Administration, *n.d.*). Another airline's FOQA analysis confirmed that the incidence of descent rate deviations during approaches were significantly higher at a particular runway enabling the amendment of the air traffic instrument flight procedure (U.S. Government Accountability Office, 1997). A different airline's FOQA program revealed pilot deviations occurred more frequently during visual flying than during instrument flying conditions, thereby prompting the airline's flight training managers to rethink the relative emphasis given visual vs. instrument flying in the airline's training program (U.S. Government Accountability Office, 1997). High speed or excessively steep landing approaches can lead to runway excursions on wet or slippery runways as well as excessive wear on the aircraft's tires and brakes. Thus, improvements in pilot behaviors and air traffic procedural improvements were possible with the availability of flight data obtained from these FOQA programs. Finally, data presented by Captain Mike Holtom, British Airways, at an international safety seminar in Rio de Janerio, Brazil in November 1999 revealed interesting potential long term safety benefits of adopting a FOQA program.

An aviation insurance company recently overlaid FAA data for U.S. airlines not using FOQA with that of non-U.S. carriers which have FOQA programs. The comparison

> revealed that airlines using such data for seven to 14 years have a lower accident rate than U.S. airlines which do not have FOQA programs in place. The comparison also revealed that those airlines which have used FOQA for more than 14 years have an accident rate under half that experienced by U.S. carriers (Holtom, 2000, p. 7).

FOQA programs have also improved maintenance practices (Fernandes, 2002). Aircraft maintenance programs require routine inspection of aircraft systems and special inspections if aircraft operating limitations are exceeded. A special maintenance inspection is typically required in order to identify any damage caused by extending the flaps at high speed, or failing to retract the flaps prior to acceleration. FOQA data provide an objective method of detecting deviations by pinpointing the exact time and severity of the flight crews' oversight (Pfleiderer & Chidester, 2011). Without FOQA, management must rely upon subjective pilot reporting, and the pilot's diligence entering handwritten records into the aircraft's logbook.

FOQA has improved safety at a small public sector air operator as well (Lowe et al., 2012). FAA's Aviation System Standards (AJW) flight inspection program operates small turbo-jet and turbo-propeller aircraft used for inspecting FAA's navigational facilities to assure the accuracy of their guidance signals that aircraft rely upon for lateral and vertical guidance while landing in poor visibility conditions. FAA aircraft must conduct non-standard flight maneuvers at very low altitudes to ascertain the signal accuracy of the navigation facility and enable FAA technicians to calibrate and recalibrate the Instrument Landing Systems (ILS) that guide aircraft safely to the ground. Thus, FAA's flight inspection pilots operate aircraft in areas of higher risk than typical air operators engaged in routine air transportation. FAA's public sector operations are not unique. For example, the U.S. Forest Service routinely operates aircraft at tree-top level

during fire-fighting operations and the U.S. Coast Guard rescue missions require their pilots to conduct high risk flight operations.

FAA's flight inspection FOQA program began in 2006 and quickly provided safety benefits to the operation and the organization's pilots. FOQA revealed that pilots were routinely leaving the aircraft's autopilot engaged below safe operating limits, i.e., less than 50 feet above the ground (Federal Aviation Administration, 2011). Leaving the autopilot engaged outside of normal safe operating limits (generally 200 feet above the ground) can result in an aircraft accident or serious incident if the autopilot malfunctions because the pilot will not have enough time and available altitude to recover the aircraft before it strikes the ground.

The FAA flight inspection FOQA program revealed these unsafe routine practices enabling the development of animated training programs using the FOQA data that was delivered as a powerful safety message to the pilots. Safety improvements were rapid – a 39% reduction in unsafe behavior within three months and a 45% reduction within six months (Federal Aviation Administration, 2011).

FOQA's Economic Benefits

Electronic monitoring of pilot performance through FOQA can be an economic benefit to large air carrier operators because it can prevent an aircraft from being removed from revenue service because of a component failure. For example, FOQA data has been used to detect and notify management when an aircraft's engine has exceeded its maximum temperature limitation as well as the elapsed time the limit was exceeded. This information is critical for avoiding engine component failure and obtaining the manufacturer's expected time between overhauls and/or part replacement intervals. Finally, FOQA programs have been used to monitor aircraft

fuel consumption (Fernandes, 2002; Stolzer, 2002). Specifically, FOQA enables the operator to identify aircraft which are burning more fuel than expected, "possibly due to misalignment of components increasing aircraft drag, thereby resulting in knowledge, correction and economic savings for the operator" (Fernandes, 2002, p. 43).

FOQA for Small Operators

The Flight Safety Foundation Corporate Advisory Committee began a demonstration project in 2002 to assess the feasibility of using FOQA to improve corporate aviation safety (Lacagnina, 2007). The NTSB placed renewed emphasis on FOQA in 2009 during public hearings on the safety of helicopter emergency medical service providers. Following the hearings, a joint statement of support for voluntary FOQA was submitted by the Helicopter Association International (HAI) and the Air Medical Operators Association (AMOA), while the NTSB recommended that FAA "require helicopter emergency medical services operators to install flight data recording devices and establish a structured flight data monitoring program that reviews all available data sources to identify deviations from established norms and procedures and other potential safety issues" (U.S. National Transportation Safety Board, 2009, p. 18).

FAA Administrator Randy Babbitt also renewed the agency's emphasis on voluntary FOQA throughout the entire aviation industry in 2010 during a meeting with aviation industry leaders (Federal Aviation Administration, 2010). Although FAA has continued to strongly support FOQA over the past 15 years, it has not been voluntarily implemented by most small aircraft operators (U.S. National Transportation Safety Board, 2009). Thus, the significant safety and economic benefits seen by large air operators, over subjective pilot reporting and traditional

post-accident/incident forensic analysis, has not permeated the small air operator sector (Federal Aviation Administration, 2010).

FOQA Technology Advancements

The 1990's was a time of rapid computer hardware and software advancement enabling digital recording and data processing/analysis capabilities. Typically, only 16 to 29 parameters were recorded on crash resistant flight data recorders used for post-accident analysis by the National Transportation Safety Board; however the rapid advancement of modern digital aircraft now allows for a comprehensive set of conditions to be monitored on non-crash resistant Quick Access Recorders (QAR's) that are able to monitor 200-500 parameters by sensing output from the aircraft's Digital Flight Data Acquisition Unit (DFDAU)**,** the same device feeding the post-accident flight data recorder (Holtom, 2000). This revolution in information and computer technology also resulted in QAR's being able to hold 100 to 200 hours of flight data which are then accessible by removable optical disk or personal computer memory cards (U.S. Government Accountability Office, 1997). Increases in computing power enabled the rapid analysis of flight data on personal computers. The evolution of data link systems provides transmission of large digital data streams being directly supplied to central ground-based analysis systems (Holtom, 2000). Thus, near real time flight data monitoring programs, as well as the compilation of industry wide data has become a real possibility. The continued miniaturization of computer technology over the past decade, with commensurate affordability and PC computer graphics, enables small operators to obtain the benefits of "one of the most powerful safety tools available" (Lacagnina, 2007, p.11).

FOQA Costs

FOQA implementation requires investment in equipment, training and personnel. Physical equipment expenditures include investment in Quick Access Recorders (QARs), recording/replay media and computers for data analysis. A typical QAR costs approximately $20,000; however, the aircraft downtime to install the QAR, plus the costs of spares must also be considered (Lacagnina, 2007). FOQA equipment is not the greatest cost in implementing FOQA. It accounts for only 15% of the total while "80% of FOQA's costs are typically associated with personnel" (Fernandes, 2002, p. 28).

The recent reductions in technology costs have brought the opportunity for smaller aircraft to benefit from FOQA's electronic pilot monitoring systems. Historically, some air carriers were deterred because they perceived FOQA as relatively expensive in initial capital costs of hardware and operational costs, to include computer software (U.S. Government Accountability Office, 1997); however by 2007 the total cost for the equipment required to participate in a FOQA program had dropped to the range of $10,000 to $13,000 (with an additional $2,000 of aircraft installation costs) (Lacagnina, 2007). By 2009, the NTSB stated that technology existed to build image and data recording devices that were relatively inexpensive and lightweight for installation on new and existing small aircraft, and the advances in technology have resulted in the ability to implement FOQA with fewer personnel per aircraft (U.S. National Transportation Safety Board, 2009). Thus, the recent rapid advances in FOQA technology, commensurate with the reduction in technology and human capital investments required to implement FOQA, enable even the smallest operator to obtain the safety benefits of electronic pilot monitoring. Furthermore, opportunities exist for small operators to pool

resources and data to leverage both safety and economic FOQA benefits (Lacagnina & Rosenkrans, 2004; Lacagnina, 2007).

Mandatory or Voluntary FOQA?

The concept of FOQA as a voluntary pilot monitoring program became an institutionally accepted practice within the United States over the past quarter century. The safety benefits of flight data monitoring programs have been recognized by the 188 contracting states of the International Civil Aviation Organization (ICAO). ICAO established electronic flight data monitoring as an international standard required for international operations of turbine powered aircraft having a maximum take-off weight of over 59,525 lbs. (International Civil Aviation Organization, 2001). In addition, ICAO recommended the adoption of a flight data analysis program for turbine aircraft with a maximum take-off weight in excess of 44,093 lbs. This ICAO Standard and Recommended Practice (SARP) went into effect on January 1, 2005 (International Civil Aviation Organization, 2009).

China was the first civil aviation authority to mandate a flight quality assurance monitoring program in 1997 followed by the French civil aviation authority in 2000 (Fernandes, 2002). In 1998, the FAA decided to continue to encourage voluntary adoption of FOQA for all U.S. registered aircraft regardless of size. According to FAA's FOQA program manager, Dr. Thomas Longridge: "it would be premature for FAA to mandate FOQA because U.S. aviation is in the early stages of developing FOQA and is primarily in a learning mode" (Lacagnina & Rosenkrans, 1998, p. 5). Thus, the FAA continued with FOQA as a voluntary program and filed a difference with ICAO in 2005 notifying member States of the U.S. choice to be in

noncompliance with the ICAO requirement on flight data analysis programs. A difference is a formal notification to ICAO of a State's noncompliance with an annex required by Article 38 of the Chicago Convention.

ICAO member states may choose to accept or reject the U.S. stance against mandatory FOQA because other countries are not obligated to honor the United States difference. They may legally deny airspace entry to any aircraft or operations not in compliance with ICAO requirements. FAA has become aware of at least four instances where the lack of a flight data analysis program has resulted in small air operator turbine powered aircraft (in excess of 59,525 lbs.) being denied entry into foreign airspace due to the lack of United States compliance with the mandated ICAO standard on flight data analysis (Federal Aviation Administration, 2010a).

The February 12, 2009 accident of a Colgan Air Continental Connection Flight 3407 in Buffalo, New York resulted in another FAA safety summit primarily directed at regional and smaller air operators for the purpose of identifying and implementing safety improvements (U.S. FAA, 2010). A key outcome was the verbal commitment by the smaller air operators to expand their implementation of voluntary safety FOQA programs and "develop data analysis processes to ensure effective use of the digital data" (Federal Aviation Administration, 2010a, Appendix 2, p. 2).

Safety Management Systems and FOQA

FOQA has been linked with the implementation of a Safety Management System in the international community. The International Civil Aviation Organization (ICAO) has defined a Safety Management System (SMS) as a systematic approach to managing safety which includes

the necessary organizational structures, accountabilities, policies and procedures including a mandatory FOQA program to be part of the air operators SMS for international operations (International Civil Aviation Organization, 2009). In 2006, ICAO adopted the international SMS standard to take effect on January 1, 2009. Thus, SMS and FOQA have been adopted by the international aviation community as an international standard governing global flight operations for the past four years.

The FAA defines a Safety Management System (SMS) as a structured, risk-based approach to managing safety in both its internal organization notices and in the federal register for the purposes of continuing improvements in accident rates (Federal Aviation Administration, 2008, 2009). The commercial accident rate has decreased substantially over the past 10 years; however the FAA's Office of Accident Investigation and Prevention identified 129 accidents involving air carrier aircraft from 2001 to 2010 that could have been mitigated if air carriers had implemented a safety management system to identify hazards in their daily operations and developed methods to control risk (Federal Aviation Administration, 2010b). Congress directed, in August 2010 (Public Law 111-216), that FAA propose a Safety Management System regulation governing large air carrier operations under CFR 49 FAR Part 121 (Airline Safety and Federal Aviation Administration Extension Act, 2010). Although FAA proposed an SMS regulation in the Federal Register in November 2010 (Federal Aviation Administration, 2010b), no final SMS rule has been published, nor have any firm SMS compliance dates been established in nearly three years. In addition, no SMS regulatory proposal has been announced for the small air operators operating turbo-jet aircraft in domestic or international airspace. These small operators are projected to grow at an average of 3.5 % per year between now and 2033 (Federal Aviation Administration, 2013). Finally, Congress also directed the FAA to *consider mandating*

existing voluntary safety programs such as FOQA (italics added) as part of the FAA's final Safety Management System regulation (Airline Safety and Federal Aviation Administration Extension, 2010); however FAA's unpublished predecisional draft SMS regulation does not mandate FOQA as part of FAA's proposed new SMS regulation governing large air carrier operations (Federal Aviation Administration, 2011b).

FAA's new proposed SMS regulations require "the certificate holder to develop and maintain processes to analyze safety risk and *maintain processes and systems to acquire data* (italics added) with respect to its operations, products and services in order to monitor the safety performance of the organization" (Federal Aviation Administration, 2011b, Sections 5.55 (a), 5.71). Thus, air operators will be required to decide on the methods they will use to acquire safety data that will provide a robust composite picture of operational safety performance. On the other hand, FAA's new proposed regulations do not require or specify the types of systems FAA expects air operators to use to assess system safety.

"Safety Management is not an add-on, but an essential part of the system's core business" (Reason, 1997, p. 114), and therefore safety management requires an effective safety information system. "An effective safety information system is the principal basis of an informed safety culture" (Reason, 1997, p. 194) and is of critical importance; however FAA will rely upon industries' decisions regarding the types of data collection methods they chose to use in implementing their safety management system. FOQA will remain a voluntary program for all U.S. air operators regardless of size under FAA's new proposed SMS regulations.

Targeting Safety Risk and Data Sharing

FAA's Safety Management System regulations, as currently proposed, do not mandate the adoption of FOQA, nor does the SMS regulation require air operators to share their voluntary safety monitoring data with the FAA. On the other hand, FAA intends to rely upon data-driven risk management to allocate FAA resources for safety oversight by "processing and analyzing internally and externally developed data, identifying hazards and analyzing risk directly to FAA safety oversight processes and conducting audits of industry SMS activities" (Federal Aviation Administration, 2008, p. 13). The GAO raised concerns over two decades ago reporting the following in 1991:

> FAA does not determine which airlines pose the greatest safety risks. Although FAA maintains numerous data bases with safety-related information, it does not integrate such data as accidents, incidents, pilot deviations, and inspection results to assess overall airline risk and to determine how it could best use its limited inspection resources. In 1987, we reported that FAA could develop criteria for targeting inspections at high-risk conditions and noted that targeting is important because FAA will never have sufficient resources to inspect all carriers all of the time. (U.S. Government Accountability Office, 1991, p. 7)

Four years later in 1995, the GAO expressed concern about FAA's ability to identify aviation safety risk precursors because of the reliance on data from numerous databases that contain incomplete, inconsistent and inaccurate data (U.S. Government Accountability Office,

1995). Thus, FAA's safety related decisions will not be reliable and will not effectively support FAA's inspection and certification mission (U.S. Government Accountability Office, 1995).

Data sharing and data analysis are especially important for safety at small air operators. Von Thaden reported that small air operators had significantly higher safety risk factors associated with inadequate training, procedural standardization issues, and inadequate supervision and surveillance as compared with their large air operator counterparts (Von Thaden & Wiegmann, 2011). The GAO reported that small air operators had higher accident rates and received few if any inspections by the FAA (U.S. Government Accountability Office, 1991). More recently in 2010, the GAO concluded that vulnerabilities in aviation data systems, and the lack of FAA access to industries' safety information, would limit the usefulness for the safety analyses system planned to support FAA's oversight of air operator's SMS programs (U.S. Government Accountability Office, 2010). In addition, the Department of Transportation's Office of Inspector General was also critical of FAA's ability to conduct safety trend analysis due to limited access to data for FAA's new Aviation Safety Information Analysis System known as ASIAS (U.S. Department of Transportation, Office of the Inspector General, 2009). In order for safety risk modeling to be successful at targeting the areas of greatest safety vulnerability, risk models must contain adequate data and be validated and revalidated against actual outcomes in order to be effective as a safety alerting tool. "A successful model tells you things you didn't tell it to tell you" (Hubbard, 2009, p. 214).

Protection of FOQA Data

Employees are well aware that digital data can easily be broadly distributed. Grant & Higgins (1987) found an employee perception's of computer monitoring was negatively associated with an increase in size of the potential audience of the data. They proposed that broader distribution of electronically gathered data to senior managers reduced the acceptance of electronic monitoring of employees (Grant & Higgins, 1987).

The FAA promoted the protection of FOQA data from wide distribution when it convened an airline safety summit in 1995 attended by over 1,000 aviation industry leaders (Phillips, 1995). At the conclusion of the conference, FAA Administrator David Hinson issued a policy statement in which FAA stated the agency would refrain from using FOQA data in FAA enforcement actions against airlines and pilots when such data was part of an approved FAA FOQA program established by the air operator (Phillips, 1995; Trautman, 1995). Three years later, the FAA engendered industry trust by agreeing to strip FOQA data of information that might identify pilots, and Administrator Jane Garvey committed the FAA to a policy prohibiting the agency from using de-identified FOQA information in enforcement actions except in egregious cases (McKenna, 1998). That same year (1998), the International Civil Aviation Organization developed Standards and Recommended Practices (SARPs) for flight data analysis protection. The U.S. Congress also established legal protection of voluntarily submitted FOQA data to the FAA through passage of CFR 49 U.S.C. 40123. Finally, in 2001, the FAA enhanced its previous commitment to FOQA data protection through the passage of Federal Aviation Regulations Part 193 protecting FOQA data from public disclosure.

The FAA hoped and expected that all of these federal and international efforts would promote the expansion of voluntary adoption of FOQA programs into the broader aviation community, and adoption of FOQA by the large air carriers continued to slowly expand in the large air carrier sector with 45% adopting the program by the end of 2010 including seven of the top eight largest U.S. passenger carrying operators (Federal Aviation Administration, 2010b). On the other hand, smaller air carriers and federal public sector aviation operators (i.e., U.S. Forest Service, NASA, NSF etc.), as well as business aviation operators did not adopt FOQA despite the governments' data protection initiatives cited above. The Flight Safety Foundation's C-FOQA demonstration project for business jet owners and operators resulted in only two organizations participating due to "unresolved questions about data protection and resistance by pilots" (Lacagnina, 2007, p. 12). Similar concerns were also raised in a series of 12 FAA industry safety forums held across the United States in 2010 (Federal Aviation Administration, 2010).

By 2010, only 17% of the small air operators had voluntarily adopted FOQA (U.S. Government Accountability Office, 2010), and only one public sector operator (FAA's own flight inspection program) chose to voluntarily adopt it despite the safety benefits that electronic pilot monitoring could have on the specialized aircraft missions performed by small operators in the public sector (Federal Aviation Administration, 2011).

Litigation and FOQA Data

Individual supervisors, air operators and the FAA have limited control over the release of FOQA data in civil or criminal litigation. Privacy and access to digital data by civil courts followed the crash of Comair flight 5191 in 2006 when a flight crew departed on the wrong

runway. Comair had encouraged voluntary safety reporting by its pilots under FAA's Aviation Safety Action Program (ASAP). ASAP is a program that encourages voluntary reports of mistakes and operational anomalies. ASAP reports are supposed to remain confidential, under similar federal regulations protecting FOQA programs, but the U.S. District Court serving eastern Kentucky ruled that Comair's ASAP reports must be released to the plaintiff's attorneys for use in their wrongful death suits against Comair (Velocci, 2008). The judge ordered the plaintiffs' attorneys to keep the records from the public in an attempt to retain the incentive for continued submission of voluntary safety reporting (Velocci, 2008). The judge stated:

> "The allowance of the privilege to withhold evidence that is demonstrably relevant in a…trial would cut deeply into the guarantee of due process of law and gravely impair the basic function of the courts [and] it is the opinion of this Magistrate Judge that the failure of Congress to create any privilege for ASAP reports weighs heavily against the creation of any privilege by this Court" (Comair's motion for a protective order…, 2008, p. 7, p. 11).

Thus, there is no guarantee FOQA data can always be protected from release even though 49 U.S.C. 40123 and Title 14 of the Code of Federal Regulations Part 193 established legal protection of FOQA data from public disclosure. It remains unclear what affect the judge's ruling in the Comair ruling will have on the future release of FOQA or other voluntarily reported safety data in future wrongful death lawsuits; however even FAA acknowledges conditions when FAA will share FOQA data with outside organizations under 14 CFR section 13.401(e): "…the FAA may release FOQA information in support of enforcement actions that involve criminal or deliberate acts" (Federal Aviation Administration, 2003, p.5).

Maurice Halbwachs stated in his 1950 work *The Collective Memory* – "what stands in the foreground of group memory are the remembrances and events of collective experiences of concern to the greatest number of members" (Halbwachs, 1950, p. 43). Certainly the release of FOQA data through the judicial system creates a collective experience of group memory for many pilot groups and may be a factor in pilot perceptions of electronic monitoring under FOQA.

Prosecuting Pilots

The potential for civil and/or criminal suits against individual pilots exists. The International Civil Aviation Organization leaves the decision regarding prosecution of aviation professionals to each individual State as outlined in Article 12 of the Chicago Convention: "Each contracting State undertakes to insure the prosecution of all persons violating the regulations" (Mateou & Mateou, 2010, p. 20). An Air France pilot was convicted of involuntary manslaughter in 1956 when his DC-6 aircraft crashed and killed 56 passengers during an approach to the Cairo airport (Dekker, 2009). Since then, many countries including the U.K, Japan, New Zealand, China, France, Argentina, Italy, Switzerland, Canada, the Netherlands, Portugal and Spain have been involved in the criminalization of pilots and other aviation professionals - "Aviation professionals can be criminally prosecuted for their negligent, albeit unintentional, acts or omissions…" (Mateou & Mateou, 2010, p. 20). Thus, the means, methods, process and policies of holding airmen accountable for their actions varies around the globe.

The Airline Pilots Association (ALPA) gave Congressional testimony on July 27, 2000 during which they expressed their concern about the growing global trend to prosecute pilots.

> Although criminal prosecution of commercial pilots has not been an issue in the United States to date, ALPA pilots are becoming increasingly concerned about the possibility of criminal liability. This concern is generated primarily due to the increased foreign operations of U.S. air carriers. Pilots now operate over and into countries whose criminal laws are considerably different than those of the United States (*The trend towards criminalization*, 2000, p. 3).

ALPA expressed concern that the threat of criminal prosecution undermines pilot cooperation and the providing of information and data that is of assistance in determining the probable cause of the accident and the prevention of recurrence (*The trend towards criminalization*, 2000).

A State's investigatory body has access to extensive amounts of post-accident data that might lead to an individual airmen being prosecuted with FOQA data implicating the pilot in negligent acts or omissions even if they were unintentional. In 2001, ICAO addressed the disclosure of records leaving wide judicial discretion to the State:

> The State conducting the investigation of an accident or incident, wherever it occurred, shall not make the following records available for purpose other than accident or incident investigation, unless the appropriate authority for the administration of justice…determines that their disclosure outweighs the adverse domestic and international impact such action may have on that or any future investigations (ICAO, 2001, Annex 13, paragraph 5.12).

The prospect of criminal prosecution of a pilot in the United States became close to reality when the Queen's District Attorney convened a grand jury to determine if criminal

charges should be pursued following the accident of USAir Flight 5050 at LaGuardia Airport in 1989 when 61 survivors were pulled from the East River following the aircraft skidding off the runway due to the pilot failing to detect an improperly positioned rudder trim control (*Safety Board Blames Pilot for Fatal USAir Accident*, 1990).

Convicting Pilots and other Aviation Personnel

"On June 26, 1988, a brand new Airbus A320 crashed during an air show in Habsheim, France. Three passengers died and 50 people were injured in the accident. Flight data recordings obtained from the aircraft implicated the actions and omissions of the pilot. A judicial investigation was subsequently launched wherein the pilots were accused of manslaughter. The prosecution relied heavily on the FDA data that was admissible in court resulting in the captain of the flight being sentenced to six months in prison and a 12 month probation being given to the co-pilot" (Mateou & Mateou, 2010, p. 58). More recently, in July 2000, Judge Dominique Andreassier found Continental Airlines and a mechanic guilty of manslaughter in the crash of Air France's Concorde Flight 4590. The French court ruled that there was an "incontestable link" between the negligence of a Continental maintenance engineer and the fuel tank rupture and subsequent fire that made the aircraft uncontrollable when the French Concorde ran over a metal strip that had been dropped on the runway by a departing Continental DC-10 aircraft minutes earlier (Flottau & Wall, 2010, p. 37). Commentary on the French court ruling convicting the Continental mechanic of manslaughter stated: "Unlike the U.S. and many other countries, French policy-makers reject the idea- in the aftermath of crashes or serious incidents- of relying on the decisions of technical investigators. Instead, the French Justice Department runs an independent, parallel probe- culminating in taking the case to court" (Sparaco, 2010, p. 81).

Flight 52 of ValuJet crashed in the Florida Everglades at a speed of 400 miles per hour shortly after take-off from Miami International Airport on May 11, 1996 (Walters & Sumwalt III, 2000, p. 103). Improperly packed oxygen generators (prepared by Sabre Tech) ignited an uncontrollable fire which burned through control cables filling the cabin and cockpit with smoke resulting in all 105 passengers, the pilot, copilot and three flight attendants being killed (U.S. National Transportation Safety Board, 1996). "The US Federal and Florida State Prosecutors brought criminal charges, 110 counts of manslaughter and 110 counts of third degree murder against ValuJet's maintenance contractor Sabre Tech" (Mateou & Mateou, 2010, p. 61). Although Sabre Tech was ultimately acquitted of the federal charges, it was only because the US 11th Circuit Court of Appeals could not find "an intent to harm" (Mateou & Mateou, 2010, p. 62) and Sabre Tech was given a $500,000 fine with three years' probation. "Sabre Tech was the first American aviation company to be criminally prosecuted for its roles in an American airline crash" (Mateou & Mateou, 2010, p. 61).

The more recent ruling by the U.S. district court in the Comair case of 2006 may be more relevant to pilots concerned about the release of air operator data because the judge compelled the release of voluntarily gathered data for use in a wrongful death litigation raising the increasing likelihood that the United States would follow much of the rest of the world in the pursuit and prosecution of pilots for negligent acts or omissions even if they were unintentional. "There are a number of factors, such as the media, political pressure and financial interests, that may influence the prosecution of pilots" (Mateou & Mateou, 2010, p. 97). Thus, the growing initiation of criminal and/or civil prosecution of pilots, coupled with the court's access to FOQA data, could be associated with negative pilot perceptions of FOQA and a detriment to the wider adoption of voluntary FOQA programs in the United States.

Employee Perceptions of Electronic Monitoring

Research on the relationship between electronic monitoring and employee perceptions of fairness revealed conflicting conclusions. Alder (2001) found routine versus occasional electronic monitoring led to increased perceptions of fairness by employees. On the other hand, Grant and Higgins (1987) found that employees accepted electronic monitoring measures as more objective, but not necessarily as "fair" (Grant & Higgins, 1987, p. 105), while Aiello and Kolb (1995) found that individual electronic monitoring systems were less likely to be accepted by employees, than broader monitoring systems. They found higher perceptions of fairness when group performance was monitored (Aiello & Kolb, 1995).

FOQA programs routinely monitor all flights and all pilots operating a FOQA equipped aircraft. Thus, electronic monitoring of pilots by FOQA is objective as compared to traditional subjective pilot evaluation reports submitted by check airman, flight instructors and/or training evaluators. Therefore, pilot perceptions of FOQA could be perceived as more positive and less negative when a FOQA program is in place possibly due to the perceived improvement over traditional subjective pilot monitoring systems. On the other hand, operators with FOQA programs have not eliminated the existing subjective pilot monitoring systems already in place and FOQA could be perceived by pilots as a form of electronic surveillance. Thus, pilots operating under FOQA may have more negative perceptions and fewer positive perceptions of FOQA than their unmonitored counterparts.

Views of electronic monitoring may even vary depending upon the language used to describe the monitoring system. For example, Grant and Higgins (1987) found 52% of surveyed

respondents believed all electronic surveillance should be illegal whereas only 30.5% agreed when the system was called electronic monitoring.

Kidwell and Bennett (1994) found that employee perception of procedural fairness is an important antecedent of attitudinal responses to the use of Electronic Control Systems (ECS). Procedural fairness of ECS was measured by asking employees how fair they regarded the procedures used to evaluate their work performance using the electronic control system. They found that feedback sign (positive or negative), feedback frequency, and supervisor consideration were positively and significantly related to computer-monitoring satisfaction (r^2 = .45). When procedural fairness was included it raised the overall adjusted r^2 to .53 accounting for over 50% of the variance and they concluded: "that controlling for performance appraisal/feedback variables and employee attitudes toward the appropriateness of monitoring, the perceived procedural fairness of an ECS will be positively related to employees' satisfaction with the system" (Kidwell & Bennett, 1994, p. 206, p. 210).

McNall and Roch (2009) examined a theoretical model focusing on how Electronic Performance Monitoring (EPM) practices influenced interpersonal and informational justice which they contended were relevant in building trusting relationships between monitored employees and their supervisors. They found the presence of an explanation for electronic monitoring was positively related to perceptions of informational justice (McNall & Roch, 2009). A survey of 960 Internal Revenue Service employees indicated the perception variation of electronic monitoring could be attributed to the employee's prior belief about monitoring (Vaught, Taylor, & Vaught, 2000). A recent FAA report indicated that employee perception and trust issues continue as challenges to air operators that have implemented a FOQA program (Federal Aviation Administration, 2011a). Thus, the manner in which FOQA is implemented and

ultimately used by the air operator's management, and other parties, may be associated with increased positive perceptions and decreased negative perceptions of FOQA.

Targeting individual or organizational performance?

Management and employee behaviors and attitudes contribute to the formulation of an organizational culture (Alder, 2001). Grant and Higgins (1987) found that "supervisors played a critical role in determining whether monitoring would be stressful and whether feedback would undermine or promote satisfaction" (Grant & Higgins, 1987, p. 110). Today's electronic monitoring systems can be used by management to target individuals, and/or to improve organizational performance.

Kidwell and Bennet (1994) found that electronic monitoring programs can lead to undesirable employee responses such as withdrawal, sabotage, and diminished citizenship-like behavior. Grant and Higgins (1987) found that "monitored employees were less likely to pursue complex customer inquiries, than their unmonitored coworkers, and they complained more of hostile or stressful work groups" (Grant & Higgins, 1987, p. 105).

Employee involvement is the keystone to identifying the weakness and vulnerability of safety deficiencies before an aviation accident occurs (Wiegmann & Hui, 2011). Certain organizational factors have been related to commercial aviation accidents (Von Thaden & Wiegmann et. al., 2011). FOQA enables the development of an informed safety culture which is defined by James Reason as one in which those who manage and operate the system have current knowledge about the human, technical, and organizational factors that determine the safety of the system as a whole (Reason, 1997). An effective organizational safety culture conveys a sense of

identity for organization members and facilitates the generation of employee commitment connecting organizational behavior with management interests (Wiegmann & Hui, 2011).

Alder (2001) found that supportive organizational cultures can improve employee attitudes and acceptance of electronic monitoring. On the other hand, trust in a supervisor does not necessarily translate into organizational trust because the implementation of universal procedures in a just manner typically forms the basis of the employee's trust of their organization (Pearce & Klein, 2010). Thus, management and supervisory attitudes and behaviors may have considerable influence on the pilots' perceptions of FOQA and on the ultimate development of an informed safety culture.

Experience and Trust Relationships

Pearce and Klein (2010) researched the relationship between greater employee experience and trust levels of their employer. They found a negative correlation. Specifically, they found organizational tenure was negatively associated with organizational trust after controlling for age, supervisory trust, and organizational commitment (t= -3.11; p<.01) (Pearce & Klein, 2010). This same pattern was also found with employees in a large government agency (Pearce & Klein, 2010). Pearce and Klein (2010) also proposed that increased employee experience increases the likelihood that the employee will have witnessed or personally experienced trust betrayals and procedural failures; however data was not provided that supported this proposition. A meta-analysis by Dirks and Ferrin (2002) reported reliable correlations between trust in a supervisor and improved job performance, job satisfaction, and organizational commitment by the employee (Hogan, 2007).

Similar patterns might be present within pilot communities. For example, pilots with increased FOQA experience may have increased negative perceptions of the FOQA program, as compared with pilots operating without FOQA, because of the increased opportunity for experiencing procedural failures and/or perceived betrayals of trust surrounding the use of electronically gathered FOQA data.

Trust – How Important?

Trust has been defined as "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control the other party" (Mayer, Davis, & Schoorman, 2006, p. 85). Trust has also been described as an attitude of the trustor toward the trustee (Whitener, Brodt, Korsgaard, & Werner, 2006). Managerial activities may be critical components in successfully developing a climate of transactional trust between the employer and employee when initiating an employee electronic monitoring program and trust can be damaged easily by a perceptual betrayal (Reina & Reina, 2006).

The employer's intents and purposes of their electronic monitoring programs have been associated with employee acceptance of electronic monitoring programs. If employees believe the primary focus of electronic monitoring is employee development, or to improve performance by providing training, they are more likely to accept it (Alder, 2001). McNall and Roch (2009) found the presence of an explanation for electronic performance monitoring was positively related to perceptions of informational justice (r=.51; p<.01). Previous research by Douthitt and Aiello (2001) and Alge (2001) found that monitored participants who were given the opportunity

to voice their opinion about the design and implementation of the monitoring system had higher perceptions of procedural justice as compared to unwelcomed participant input (McNall & Roch, 2009). These concepts may be critical to the establishment of an aviation culture that is perceived as a just safety culture because employees are trustful of the manner in which the voluntarily submitted data will be used (Reason, 1997).

Mayer, Davis and Schoorman (2006) found that when the situational risk is thought to be greater than the level of trust, engagement in the situational risk is less likely to occur. Pilot perceptions of trust in their employer's behavior may be a barrier preventing small air operators from adopting FOQA on a voluntary basis because an employer's initiation of an employee electronic monitoring, such as FOQA, may raise trustor/trustee issues within the air operator's smaller pilot community that the operator may desire to avoid. Concerns could potentially outweigh the hopes for the safety benefits FOQA portends.

The subsequent uses of the electronic FOQA data following implementation of FOQA may create a psychological contract breach between management and the air operators' pilots. A psychological contract breach is defined as "the subjective perception of a failure to fulfill promised obligations" (Robinson 2006, p. 333). For example, if FOQA data were used as the justification for disciplinary action, or public ridicule of a pilot, the other pilots might perceive it as a violation of informational and/or procedural justice, i.e., a psychological contract breach of the trustor/trustee relationship. Thus, pilots operating for an air operator with a FOQA program might actually have more negative perceptions of FOQA than their counterparts without FOQA due to psychological contract breaches having occurred with their employer - the air operator. Therefore, how the air operator intends, and ultimately uses FOQA data, may be a critical variable in pilots having increased positive perceptions and reduced negative perceptions of

FOQA as well as an overall stronger organizational trust of their employer. A meta-analysis conducted by McNall and Roch (2009) revealed a fairly strong relationship (r= .43) between informational justice and trust. Thus, the air operator's ultimate use of FOQA data may be critically important to the pilot perceptions of informational justice and organizational trust of their employer.

This is the first comparative survey research conducted on pilot perceptions of being continuously electronically monitored by a Flight Operational Quality Assurance (FOQA) program. Thus, this research contributes an aviation component to the body of research on employee attitudes and acceptance of electronic monitoring previously conducted by Grant & Higgins (1987), Aiello & Kolb (1995), Alder (2001), McNall & Roch (2009) and Pearce & Klein (2010). In addition, it illuminates and differentiates the relevant areas of FOQA concerns of public sector pilots whereas previous research on Flight Data Analysis (FDA) or Flight Operational Quality Assurance Programs has been generally limited to the potential safety and/or economic benefits of FOQA (Flight Safety Foundation,1992; Fernandes, 2002; Lacagnina & Rosenkrans, 1998, 2004).

CHAPTER III

METHODOLOGY

Introduction

Flight Operational Quality Assurance (FOQA) programs increase aviation safety by providing powerful insights into daily aircraft operations potentially improving pilot training, altering unsafe operational practices and lowering operating costs. FOQA programs use flight data obtained from Quick Access Recorders (QARs) that record digital flight data (e.g. speeds, altitudes, bank angles, etc.) to be easily downloaded from the aircraft and compiled for analysis for a full picture of how the pilots operated the aircraft during the entire flight. Data are gathered and automatically recorded on all aircraft with QARs that are available as retrofit or originally installed equipment. This electronic digital monitoring program also enables aircraft operators to establish pre-determined unsafe parameters that will automatically flag and trigger the time and event of the infraction for further review by supervisory and management personnel.

The Federal Aviation Administration's promotion of flight data monitoring programs began with an FAA funded Flight Safety Foundation (FSF) study in 1991. The FSF completed their landmark report in 1992 (Flight Safety Foundation, 1992) in which they coined the term "Flight Operational Quality Assurance" (FOQA). A FOQA program was defined as "a program

for obtaining and analyzing data recorded in flight to improve flight crew performance, air carrier training programs and operating procedures, air traffic control procedures, airport maintenance and design, and aircraft operations and design" (Flight Safety Foundation, 1992, p. 1). The Flight Safety Foundation report found approximately 25 air carriers with some form of a FOQA program and concluded that the appropriate use of FOQA data by airlines could result in a significant improvement of flight safety by identifying operational irregularities that could possibly foreshadow accidents and incidents (Flight Safety Foundation, 1992).

The safety benefits of flight data monitoring programs were recognized by the International Civil Aviation Organization (ICAO) which concluded that a flight-data analysis program (FDA) should be a mandatory program for large turbine powered aircraft (International Civil Aviation Organization, 2009). They subsequently required it for all member states operating internationally under Annex 6, Part 1, Amendment 33 (International Civil Aviation Organization, 2009); however the United States filed a difference with ICAO notifying member states of the Unites States' choice to have flight data monitoring programs remain voluntary for all U.S. aircraft engaged in both domestic and international air operations (Federal Aviation Administration, 2010b). Thus, FAA has publicly stated it intends to have FOQA remain a voluntary safety program for all sectors of the Unites States aviation industry.

The FAA has actively promoted FOQA programs in all aviation sectors since 1995 (Federal Aviation Administration, 1995). Forty-one of the 90 air carriers in the United States had adopted FOQA as a voluntary safety program by the end of 2010 including 22 of the 30 largest air carriers, operating more than 50 aircraft, and seven of the top eight largest U.S. passenger carrying operators (Federal Aviation Administration, 2010b). On the other hand, smaller air operators in both the public and private sector have chosen not to adopt FOQA programs even

though technology improvements and cost reductions in equipment over the past 15 years have enabled adoption into the smaller aircraft used by these operators (U.S. National Transportation Safety Board, 2009). Thus, small air operators have not experienced the significant safety and economic benefits seen by larger operators (Federal Aviation Administration, 2010).

One reason for the reluctance to adopt FOQA has been the alleged negative pilot perceptions of FOQA (U.S. Government Accountability Office, 1997, 2010). *Aviation Week and Space Technology* reported that pilots fear the misuse and release of FOQA data under provisions of the U.S. Freedom of Information Act (FOIA) and/or through civil discovery in lawsuits (McKenna, 1998). Flight Safety Foundation's demonstration project for small operators resulted in only two operators participating due to unresolved questions about data protection and resistance by pilots (Lacagnina, 2007). Similar pilot concerns were raised in a series of 12 FAA industry safety forums conducted around the country (Federal Aviation Administration, 2010), yet no survey instrument had ever been developed to assess and gather empirical information about pilot perceptions of FOQA prior to April, 2011 (Pfleiderer & Chidester, 2011). Thus, no study has ever been conducted capturing pilot perceptions of FOQA programs, or comparing the pilot perceptions of those operating under a FOQA program to those operating without one. Understanding pilot perceptions (both positive and negative) of FOQA is important because it can lead to the development of strategies that promote the voluntary adoption of FOQA, thereby expanding the aviation safety benefits of FOQA to the small air operator sector of the U.S. aviation industry.

Problem

The problem for this study is that relatively little is known about pilot perceptions of FOQA. Public sector air operators have not adopted voluntary flight operational quality assurance programs except for FAA's flight inspection flight program. The Government Accountability Office (GAO) has maintained that the reluctance to adopt FOQA can be attributed in part to the negative pilot perceptions (U.S. Government Accountability Office, 1997, 2010), but empirical research on pilot perceptions of FOQA has not been conducted to access the accuracy of this assertion. Understanding pilot perceptions of FOQA in the public sector could enhance aviation safety by leading to improved understanding of pilot perceptions and the development of mitigation strategies to expand FOQA adoption in public sector aviation programs, and thereby improve aviation safety.

Research Design

This research was descriptive and comparative in design, with respondents anonymously self-reporting to questions on a newly developed survey instrument hosted on-line. The instrument was developed by this researcher and a colleague from the Federal Aviation Administration. It is fully described below. Self-report research involves the standardized collection of quantifiable information from all the members of a population, or a representative sample, through use of a questionnaire to examine the distributions and relationship(s) among variables (Gay, 2000). In this study, pilot opinions and attitudes were assessed by eliciting the pilots' level of agreement with a series of statements about FOQA on two scales: a negative perception scale and a positive perception scale. Pilots self-reported their attitude on these scales

by using a standardized on-line data collection instrument consisting of a series of 16 Likert-type scaled questions based on expectations about possible positive safety benefits of FOQA and negative perceptions and concerns about the potential misuse of flight data collected by FOQA.

This research measured the relationship among several variables and differences in perceptions between two independent groups. "Correlational research designs are procedures in quantitative research in which investigators measure the degree of association (or relations) between two or more variables using the statistical procedures of correlational analysis" (Creswell, 2008, p. 356). The degree of association between the sets of scores reflects whether or not there is a consistent, predictable association between the scores (Creswell, 2008). Attitudes and opinions on FOQA were gathered from pilots operating in federal public sector flight programs in order to measure the degree of correlation with positive and negative attitudes about FOQA programs. This research was descriptive research because it "involved describing attitudes, opinions and preference" (Gay, 2000, p.275), and it developed themes from the data in order to form an in-depth understanding of the central phenomenon (Creswell, 2008). Finally, this research was explanatory research. Explanatory research is correlational research in order to understand the extent to which variables co-vary (Creswell, 2008).

Population

The U.S. federal government employed approximately 396 pilots in the 2010/2011 timeframe, constituting the total population of federal public sector pilots according to the U.S. General Services Administration (GSA). The GSA is responsible for monitoring and reporting on all federally operated transportation programs including federally operated aviation programs.

Federal government agencies operate aircraft in a wide variety of missions. For example, the U.S. Forest Service employs pilots who operate fire-fighting aircraft and the National Oceanic and Atmospheric Administration (NOAA) employs pilots who gather weather data. No federal public sector flight programs have implemented FOQA except the FAA's flight inspection flight program. The FAA's federal flight inspection program operates a fleet of 30 aircraft with 180 pilots located in six locations throughout the United States.

Samples

Two independent samples of public sector pilots were solicited from the total population of 396 federal public sector pilots via an on-line survey using the PFOQA survey instrument described below. FAA's flight inspection flight program constituted one independent sample of public sector pilots. This sample consisted of 188 pilots operating under a FOQA program. All 188 pilots were solicited to respond, but only 102 responses were received – a 56% response rate. The remainder of the federal public sector pilot population (n=208 pilots) operating without a FOQA program constituted the second independent sample used for research comparison. Ninety-six responses were received – a 46% response rate. Thus, the total number of responses received from both samples was 198 pilots; however all respondents did not answer all 16 survey questions. The missing values for each independent sample and number of responses to each question are reported under the frequency distribution tables found in Chapter 4.

Research Questions

1) Do FAA pilots flying under a FOQA program in the public sector have more positive perceptions of FOQA than their counterparts not flying under a FOQA program?

   Null Hypothesis: There will be no significant difference between the positive perceptions of federal public sector pilots flying with a FOQA program and their counterparts not flying under a FOQA program.

2) Do pilots flying without a FOQA program have more negative perceptions than their counterparts flying with a FOQA program?

   Null Hypothesis: There will be no significant difference between the negative perceptions of federal public sector pilots flying without a FOQA program and their counterparts flying with a program.

3) Is there a relationship between education levels and perceptions of FOQA?

   Null Hypothesis: There will be no relationship between federal public sector pilot education levels and positive or negative perceptions of FOQA.

4) Is there a relationship between positive perceptions of FOQA and the amount of experience in a FOQA program?

   Null Hypothesis: There will be no relationship between positive public sector pilot perceptions of FOQA and the amount of time spent in a FOQA program.

5) Is there a relationship between negative perceptions of FOQA and the amount of experience in a FOQA program?

   Null Hypothesis: There will be no relationship between negative public sector pilot perceptions of FOQA and the amount of time spent in a FOQA program.

Instrument Development

The Perceptions of Flight Operations Quality Assurance (PFOQA) questionnaire was jointly developed as a collaborative effort by the FAA Civil Aerospace Medical Institute (CAMI) and the FAA Aviation System Standards (AJW) organization beginning in October, 2009. The PFOQA survey was co-authored by Dr. Thomas R. Chidester, Manager of the FAA Aerospace Human Factors Research Division, and this researcher, Mr. Thomas C. Accardi, former Director of FAA's Aviation System Standards organization (Pfleiderer & Chidester, 2011). It was designed to elicit a pilots' level of agreement with a series of statements about FOQA programs on a four-point Likert-type scale (Strongly Agree, Agree, Disagree, and Strongly Disagree) (Pfleiderer & Chidester, 2011). Survey participants were asked to indicate their level of agreement with each of the statements using a scale ranging from 1 to 4, with higher values indicating agreement and lower values representing disagreement (Pfleiderer & Chidester, 2011). Individual items were coded 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, and 4 = Strongly Agree.

The 16 item questionnaire was developed based on industry concerns identified by the 1992 Flight Safety Foundation Task Force and issues reported by the United States Government Accountability Office in 1997 regarding FOQA (Flight Safety Foundation 1992; U.S. Government Accountability Office, 1997). "The Perceptions of Flight Operations Quality Assurance (PFOQA) questionnaire was designed to assess the participants' level of agreement with a series of statements regarding FOQA – a format widely recognized as one of the best for collecting information about attitudes (Nunnally, 1978)" (as cited in Pfleiderer & Chidester, 2011, p. 1). The evaluation of the reliability and validity of the PFOQA questionnaire was conducted by FAA's Civil Aerospace Medicine Institute's Human Factors Division located in

Oklahoma City, Oklahoma and published in an April 2011 report (Pfleiderer & Chidester, 2011) by the Office of Aerospace Medicine, Washington, D.C. Validity and reliability information for the PFOQA instrument is presented below.

Instrument Description

The PFOQA survey instrument consists of a series of 16 items organized into two scale dimensions containing nine positive and seven negative items (Appendix A). The positive perceptions scale consists of a series of questions eliciting pilot feedback on the potential system safety benefits of FOQA. It comprises expectations and beliefs about the pilot perceived potential safety benefits of FOQA programs. The negative perceptions scale addresses concerns about the release of FOQA data to the media and/or courts, data misuse by employers, potential use of FOQA data for disciplinary actions against pilots, and general organizational trust issues. "The PFOQA scales were based on the assumption that negative and positive perceptions of FOQA programs represent two distinct dimensions consisting of expectations about positive safety enhancements and concerns about data misuse" (Pfleiderer & Chidester, 2011, p. 2). The questionnaire contains one open-ended question at the end of the survey (*Please tell us anything else you think we should know about your expectations or concerns about FOQA*). The questionnaire also solicits the pilot's education level (i.e., Graduate degree, some graduate education, bachelor's degree, associate degree, some college, high school diploma, or less than high school diploma), and the pilots' experience with FOQA.

Instrument Pilot Test

A pretest survey is done to uncover any peculiar defects in a survey instrument and to test its broad applicability (Barbbie, 1990). The researcher contacted a former FAA colleague who was serving as a consultant for an air carrier operating with a FOQA program. This researcher requested the colleague's assistance in conducting a pilot test of the new PFOQA survey instrument in September 2009 enabling data collection and analysis by FAA's Civil Aerospace Medical Institute (CAMI). The air carrier agreed to participate and post the PFOQA survey instrument for anonymous on-line responses from the airlines' 385 pilots under the condition that their name never be disclosed in any publication. FAA's IRB approval of the PFOQA survey instrument pilot test was granted on January 7, 2010 by Dr. Thomas E. Hatley, M.D., M.P.H, Chairman, Federal Aviation Administration Institutional Review Board (IRB). The on-line PFOQA instrument pilot test was hosted by Snap Survey between Feb. 9, 2010 and March 30, 2010, and was responded to by 199 airline pilots (51% response rate) yielding enough data for assessment of the questionnaires' validity and reliability.

Scale construction and reliability was completed by the FAA's Human Factors Division researcher, Ms. Elaine Pfleiderer, during the summer of 2010, by splitting the sample using a random selection tool enabling approximately half of the cases to be used for the principal component analysis (n_1=100), and the remaining cases for the reliability analysis (n_2=99) (Pfleiderer & Chidester, 2011). Sixty-seven respondents (34%) chose to provide written comments which were used for the content analysis (Pfleiderer & Chidester, 2011).

Instrument Validity and Reliability

The PFOQA survey instruments' internal consistency reliability was assessed from the randomly split sample. Both the Positive Perceptions Scale (*a* =.86) and the Negative Perceptions Scale (*a* =.88) contained good internal consistency (Pfleiderer & Chidester, 2011). "The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (a test of partial correlation among variables) for the PFOQA questionnaire items was .80, exceeding the criterion of .60 for a good solution" (Pfleiderer & Chidester, 2011, p.6) . The FAA's Civil Aerospace Medical Institute, Human Factors Division completed their report on the validity and reliability analysis of the PFOQA survey instrument in April 2011. The report concluded that the current version of the PFOQA questionnaire was best suited for assessing pilots' attitudes prior to FOQA implementation, but the report also stated that "the PFOQA questionnaire may be sufficient for many applications in its current form even though aspects of the questionnaire could be improved" (Pfleiderer & Chidester, 2011, p. 9).

FAA Pilot Sample (Pilots in a FOQA Program) and Procedures

The FAA flight inspection program was selected as a purposive sample in support of this FOQA research. A purposive sample is also referred to as judgment sampling because it "is believed to be representative of a given population" (Gay, 2006, p.113). The purposive sample population in this research was the only available public sector group of pilots operating aircraft in the federal public sector with a FOQA program. This researcher obtained approval from FAA Institutional Review Board chairman, Dr. Thomas Hatley, to administer the PFOQA survey instrument to the FAA flight inspection pilot group, thereby complying with FAA's federal

requirements for surveying federal employees under FAA's Civil Aerospace Medicine Institute's requirements. The PFOQA survey instrument was hosted on-line between February 24, 2010 and April 28, 2010 for anonymous responses by the FAAs' 188 member flight inspection pilots of whom 102 pilots responded yielding a 56% response rate exceeding the 50% response rate that is generally considered adequate for analysis and reporting (Barbbie, 1990).

GSA Pilot Sample (Pilots Not in a FOQA Program) and Procedures

The researcher sought permission for a second purposive independent sample of federal public sector pilots from the U.S. General Services Administration (GSA). The GSA is responsible for the federal fleet including ground and air vehicles owned by the federal government (excluding the U.S. Department of Defense). This researcher had access to the appropriate officials within the GSA because of his active involvement with the promotion of FAA's aviation safety programs as the former Director of FAA's Flight Standards Service in Washington, D.C., from 1991 – 1997 with national responsibility for air carrier and general aviation operations and maintenance safety. Aviation officials from the GSA authorized, promoted, and supported the use of the new PFOQA on-line survey instrument by making it available to all federal flight program pilots (excluding FAA)– a population of 208 pilots. The GSA officials also agreed that the Oklahoma State University Institutional Review Board's approval would be an acceptable IRB approval authority for the conduct of the GSA survey. The Oklahoma State University Institutional Review Board approved the GSA survey research on July 5, 2011 (subsequently extended), and the on-line PFOQA survey was conducted for the GSA sample between August 15, 2011 and September 28, 2011. Data were gathered from this

second independent purposive sample of federal pilots that were operating without a FOQA program for comparative purposes with the FAA pilot sample operating with a FOQA program. Ninety-six responses were received (a 46% response rate). "At least 50 percent is generally considered adequate for analysis and reporting" (Barbbie, 1990, p.182). Thus, the GSA response rate was slightly lower than generally required and may have compromised external validity of the study's findings beyond the sample.

Data Analysis

The researcher was unable to obtain true random samples of the public sector federal pilot population because anonymity was required in order to obtain pilot responses to the survey. On the other hand, each pilot had an opportunity to participate if they chose to do so. Although a true random sample of pilots was not possible, Sheskin states: "it would be highly unusual to find an experiment that employed a true random sample" (Sheskin, 2007, p.1).

The *t* test was performed to address the research question: Do FAA pilots flying under a FOQA program in the public sector have a more positive perception of FOQA than their counterparts not flying under a FOQA program? The *t* test was also used to address the research question: Do pilots flying without a FOQA program have more negative perceptions than their counterparts flying with a FOQA program? This researcher also addressed whether a relationship existed between the pilot's education level and the pilots' perceptions of FOQA on either the positive or negative scales. The one-way analysis of variance (ANOVA) was used to analyze these relationships. Finally, the research examined if any relationship existed between the pilots'

experience in a FOQA program and the positive and negative perceptions of FOQA. The Pearson Product-Moment Correlation was used to research these relationships.

Table 2 presents the study's research questions, data source(s) and analysis procedures.

Table 2.

Research Questions, Data Sources, and Analysis Procedures

Research Question	Data Source	Analysis Procedure(s)
1) Do FAA pilots flying under a FOQA program in the public sector have more positive perceptions of FOQA than their counterparts not flying under a FOQA program?	PFOQA survey	Frequency distributions *t*-test for two independent samples.
2) Do pilots flying without a FOQA program have more negative perceptions than their counterparts flying with a FOQA program?	PFOQA survey	Frequency distributions *t*-test for two independent samples.
3) Is there a relationship between education levels and perceptions of FOQA?	PFOQA survey	ANOVA
4) Is there a relationship between positive perceptions of FOQA and the amount of experience with FOQA?	PFOQA survey	Pearson Product-Moment Correlation – Point-biserial correlation coefficient.
5) Is there a relationship between negative perceptions of FOQA and the amount of experience with FOQA?	PFOQA survey	Pearson Product-Moment Correlation – Point-biserial correlation coefficient.

CHAPTER IV

FINDINGS

Introduction and Overview of the Study

Flight Operational Quality Assurance Programs are electronic digital pilot and aircraft monitoring systems that enable air operators to establish pre-determined unsafe parameters that automatically monitor and record: flight control inputs, flight instruments, and power lever and flap positions etc. FOQA time stamps the recording if a predetermined parameter is exceeded marking the data for investigation. Thus, FOQA enables pilot training providers, as well as policy and standards personnel, to have an understanding of the pilot's airmanship skills and application of aeronautical knowledge, as well as his/her compliance with safe operating/approved procedures and practices. FOQA is also available to company management personnel for disciplinary purposes, regulatory authorities for pilot violation enforcement action and other parties seeking judicial action against an individual pilot and/or air operator.

The FAA has actively promoted the voluntary adoption of FOQA programs in large and small commercial aviation sectors since 1995; however only large air carriers have taken advantage of the safety benefits it provides. On the other hand, smaller public and private sector air operators have not implemented FOQA programs despite the FAA's encouragement and the advances in technology that have enabled FOQA to be used on smaller aircraft.

Aviation Week and Space Technology reported that pilots fear the misuse and release of FOQA data under provisions of the U.S. Freedom of Information Act (FOIA) and/or through civil discovery in lawsuits (McKenna, 1998). The Flight Safety Foundation attempted to solicit small operator support for FOQA in 2007 by establishing a FOQA demonstration project for small operators; however it was not successful because only two operators chose to participate due to "unresolved questions about data protection and resistance by pilots (Lacagnina, 2007). In 2010, the Government Accountability Office (GAO) maintained that the reluctance to adopt FOQA programs could be attributed in part to negative pilot perceptions of FOQA (U.S. Government Accountability Office, 2010). Thus, understanding pilot perceptions of FOQA may contribute to the further adoption of FOQA programs by small operators and thereby improve aviation safety.

Research on pilot perceptions of FOQA has not been conducted, and relatively little is known about pilot perceptions of FOQA programs. Furthermore, a valid and reliable research survey instrument to capture pilot perceptions of FOQA was not available until April 2011. The purpose of this research was to compare the pilot perceptions of FOQA within the federal public sector. The research compared positive and negative perceptions of pilots operating for federal public sector air operators with a FOQA program (FAA pilot sample), with those federal public sector pilots operating without one (GSA pilot sample).

Research Questions

1) Do FAA pilots flying under a FOQA program in the public sector have more positive perceptions of FOQA than their counterparts not flying under a FOQA program?

   Null Hypothesis: There will be no significant difference between the positive perceptions of federal public sector pilots flying with a FOQA program and their counterparts not flying under a FOQA program.

2) Do pilots flying without a FOQA program have more negative perceptions than their counterparts flying with a FOQA program?

   Null Hypothesis: There will be no significant difference between the negative perceptions of federal public sector pilots flying without a FOQA program and their counterparts flying with a program.

3) Is there a relationship between education levels and perceptions of FOQA?

   Null Hypothesis: There will be no relationship between federal public sector pilot education levels and positive or negative perceptions of FOQA.

4) Is there a relationship between positive perceptions of FOQA and the amount of time spent in a FOQA program?

   Null Hypothesis: There will be no relationship between positive public sector pilot perceptions of FOQA and the amount of time spent in a FOQA program.

5) Is there a relationship between negative perceptions of FOQA and the amount of time spent in a FOQA program?

   Null Hypothesis: There will be no relationship between negative public sector pilot perceptions of FOQA and the amount of time spent in a FOQA program.

Data Gathering Process

The PFOQA survey instrument was used to gather data from two independent public sector pilot samples – one operating with a FOQA program (FAA pilot sample) and one operating without a FOQA program (GSA pilot sample). Data was gathered on a series of sixteen items organized into two scale dimensions containing nine positive and seven negative items. "The PFOQA scales were based on the assumption that negative and positive perceptions of FOQA programs represent two distinct dimensions consisting of expectations about positive safety enhancements and concerns about data misuse" (Pfleiderer & Chidester, 2011, p. 2). The positive perceptions scale items elicited pilot feedback on the potential system safety benefits of FOQA. The negative perceptions scale items addressed pilot concerns about the release of FOQA data to the media and/or courts, data misuse by employers, potential use of FOQA data for disciplinary actions, and other organizational trust issues.

Independent Sample Comparison

A generally normal distribution was observed on both the positive and negative perceptions scales on both the FAA pilot sample and the GSA pilot sample. These are shown in Figures 2 and 3. Both samples were negatively skewed (-.17 and -.55). On the other hand, the negative perception scale of the FAA sample was positively skewed (.37), while the GSA sample was negatively skewed (-.07). Only two items were in excess of three standard deviations from a normal distribution: Item 11 in the FAA sample (*I expect FOQA data to provide our pilot group with useful feedback on our performance*), and Item 8 in the GSA sample (*I expect FOQA data to be used to optimize maintenance*). The standard deviations in both the FAA and GSA samples were similar on both the positive and negative perception scales as shown in Table 7 (*Summary*

of Means and Standard Deviations by Pilot Sample). Specifically, the standard deviation on the positive scale was .48 for the FAA sample and .52 for the GSA sample, while the standard deviation on the negative scales was .64 and .69 respectively.

The summary of the descriptive statistics for the PFOQA survey items for the sample of FAA pilots (pilots operating with a FOQA program) are shown in Table 3 (*Summary Positive Perceptions of PFOQA Questionnaire: FAA Pilot Sample*) and in Table 4 (*Summary Negative Perceptions of PFOQA Questionnaire: FAA Pilot Sample*). The summary of the descriptive statistics for the PFOQA survey items for the sample of GSA pilots (pilots operating without a FOQA program) are shown in Table 5 (*Summary Positive Perceptions of PFOQA Questionnaire: GSA Pilot Sample*) and in Table 6 (*Summary Negative Perceptions of PFOQA Questionnaire: GSA Pilot Sample*). The summary statistics contained in these four tables indicate that the composite scales meet the assumption of normality required for parametric analysis.

Table 3.

Summary Positive Perceptions of PFOQA Questionnaire: FAA Pilot Sample

PFOQA Item	N	Missing	M	SD	Skewness	Kurtosis
Positive Perceptions Scale	95	7	3.00	.48	-.17	.30
(01) FOQA is a program designed to enhance safety by identifying potential hazards….	100	2	3.42	.59	-.44	-.67
(04) Flying skills have improved or will improve with a FOQA program in place	94	8	2.74	.90	-.36	-.56
(06) I expect FOQA data to be used to take action to correct safety problems	98	4	3.30	.60	-.50	1.10
(07) I expect FOQA data to be used to improve pilot training	98	4	3.12	.69	-.36	-.17
(08) I expect FOQA data to be used to optimize maintenance	84	18	2.82	.84	-.40	-.28
(10) I expect FOQA data to be used to change cockpit procedures	97	5	3.10	.51	.17	.76
(11) I expect FOQA data to provide our pilot group with useful feedback on our….	98	4	3.07	.74	-.75	.93
(12) I expect FOQA data to be used to change procedures outside our organization	82	20	2.09	.76	.38	-.02
(13) I expect the FOQA program to positively impact the safety of our operations	95	7	3.12	.65	-59	1.26

Table 4.

Summary Negative Perceptions of PFOQA Questionnaire: FAA Pilot Sample

Negative Perceptions Scale	95	7	2.41	.64	.37	.28
(02) Gatekeepers are the only persons able to access identifying information that….	93	9	2.96	.90	-.66	-.18
(03) I trust management will not misuse FOQA data against individual pilots	97	5	2.78	.95	-.45	-.64
(05) I worry that FOQA data will be a source of information for enforcement action…	97	5	2.42	.85	.19	-.53
(09) I worry that FOQA data will be used for disciplinary actions	95	7	2.41	.83	.12	-.49
(14) A FOQA program has negatively impacted, or will negatively impact, the morale…	93	9	2.26	.79	.57	.13
(15) I worry that FOQA data could be released under the Freedom of Information Act	87	15	2.69	.81	-.17	-.41
(16) I worry that FOQA data could be released through civil litigation	88	14	2.89	.78	-.39	-.08

Individual items coded 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree

Table 5.

Summary Positive Perceptions of PFOQA Questionnaire: GSA Pilot Sample

PFOQA Item	N	Missing	M	SD	Skewness	Kurtosis
Positive Perceptions Scale	92	4	3.01	.52	-.55	2.21
(01) FOQA is a program designed to enhance safety by identifying potential hazards….	93	3	3.30	.64	-.62	.67
(04) Flying skills have improved or will improve with a FOQA program in place	89	7	2.64	.74	.18	-.45
(06) I expect FOQA data to be used to take action to correct safety problems	94	2	3.23	.58	-.39	1.49
(07) I expect FOQA data to be used to improve pilot training	94	2	3.10	.67	-.55	.84
(08) I expect FOQA data to be used to optimize maintenance	91	5	2.96	.71	-.87	1.50
(10) I expect FOQA data to be used to change cockpit procedures	94	2	3.05	.65	-.54	1.21
(11) I expect FOQA data to provide our pilot group with useful feedback on our….	94	2	3.01	.73	-.53	.45
(12) I expect FOQA data to be used to change procedures outside our organization	93	3	2.82	.69	-.35	.29
(13) I expect the FOQA program to positively impact the safety of our operations	92	4	3.02	.66	-.49	.85

Table 6.

Summary Negative Perceptions of PFOQA Questionnaire: GSA Pilot

Negative Perceptions Scale	92	4	2.56	.69	-.07	-.11
(02) Gatekeepers are the only persons able to access identifying information that….	90	6	2.77	.75	-.08	-.38
(03) I trust management will not misuse FOQA data against individual pilots	94	2	2.53	.88	-.20	-.63
(05) I worry that FOQA data will be a source of information for enforcement action…	94	2	2.60	.86	-.04	-.61
(09) I worry that FOQA data will be used for disciplinary actions	93	3	2.62	.87	-.19	-.58
(14) A FOQA program has negatively impacted, or will negatively impact, the morale…	88	8	2.28	.84	.59	-.09
(15) I worry that FOQA data could be released under the Freedom of Information Act	91	5	2.77	.93	-.19	-.88
(16) I worry that FOQA data could be released through civil litigation	92	4	2.95	.83	-.49	-.22

Individual items coded 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree

Missing Data

If a respondent did not complete all 16 items on the survey, the survey data that was submitted was utilized during the analysis. The missing data for each question appears with the number of responses for each of the 16 response items for both samples (FAA and GSA) as indicated on the tables on the previous pages. Some respondents did not complete the entire survey, however the data that was submitted was assumed to be valid for the items that were submitted and thus were included. No opinion responses were coded as missing for the analysis of individual items, and item means were substituted for no opinion values in the computation scale scores.

The FAA sample had more than twice as many missing values as the GSA sample, but most of the missing data in the FAA sample were associated with responses on Item 8 (*I expect FOQA data to be used to optimize maintenance*), Item 12 (*I expect FOQA data to be used to change procedures outside our organization [such as Air Traffic Control]*), Item15 (*I worry that FOQA data could be released under the Freedom of Information Act*), and Item16 (*I worry that FOQA data could be released through civil litigation*). Thus, the missing values on the FAA sample were limited in scope and centered on these specific items. On the other hand, most of the GSA missing values were associated with pilots who indicated that they had no knowledge of FOQA and the missing values were widely distributed throughout the survey in contrast to the FAA sample. The GSA sample consisted of pilots not flying under a FOQA program, and thus had less knowledge of FOQA's potential benefits and fewer concerns about its potential misuse.

Descriptive Statistics

Positive and Negative Perceptions Scales

The Positive and Negative Likert-type scale frequency distribution for the FAA pilot sample is shown in Figure 2 (*Frequency Distributions of FAA Pilot Sample*) The shapes of the distributions appear to be reasonably normal and no univariate outliers were observed. The GSA pilot sample (Positive and Negative Likert-type scale frequency distribution) also appears to be normal and similar to the FAA pilot sample with no univariate outliers observed as shown in Figure 3 (*Frequency Distributions of GSA Pilot Sample).*

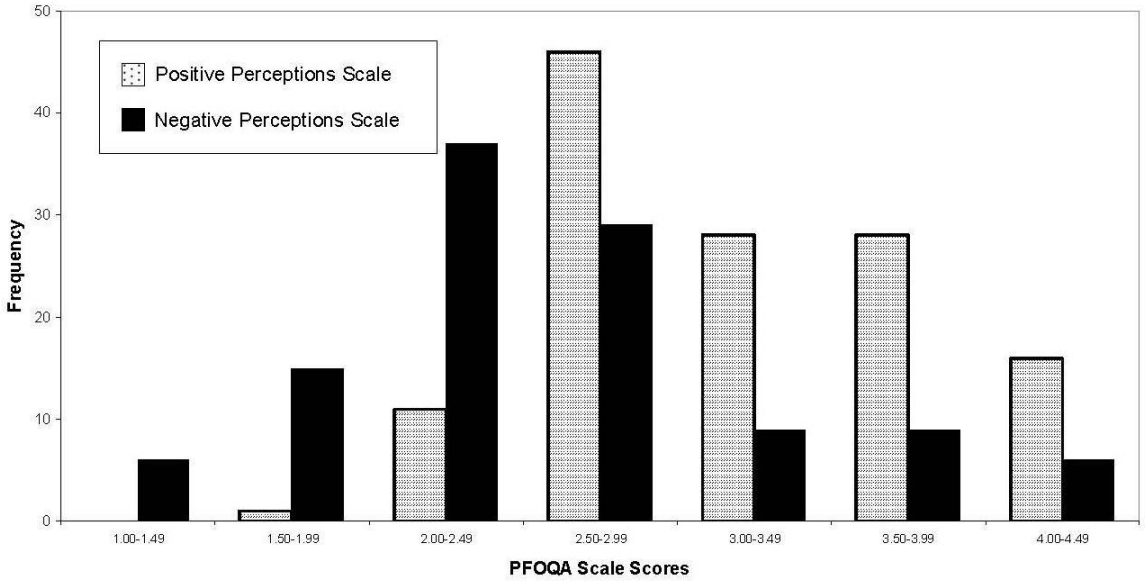


Figure 2. Frequency distributions of FAA Pilot Sample

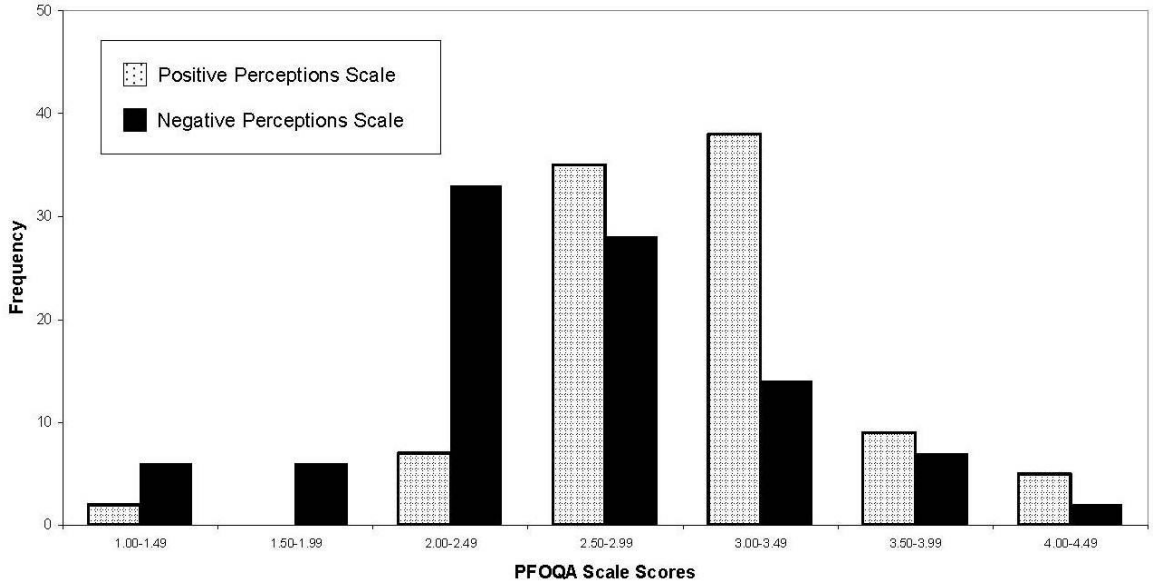


Figure 3. Frequency distributions of GSA Pilot Sample

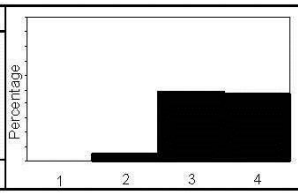
Frequency Distribution - Positive Perception Scale

The survey item frequencies and the associated percentages on the Positive Perceptions Scale items for both the FAA and GSA Pilot samples are contained in Figure 4 (*Positive Perceptions Scale Comparison*). The patterns on the responses to these Positive Perceptions Scale items for both the FAA and GSA pilot samples appeared to be very similar; however there were some notable exceptions. For example, the FAA Pilot sample demonstrated stronger levels of agreement than the GSA Pilot sample with Item 01 *(FOQA is a program designed to enhance safety by identifying potential hazards before they result in an accident).* The GSA Pilot sample was fairly evenly split between moderate levels of agreement and disagreement on Item 04 *(Flying skills have improved or will improve with a FOQA program in place)*, whereas most of the FAA Pilot sample (67.9%) agreed with this statement. The majority of GSA pilots (83.5%) indicated that they agreed with Item 12 (*I expect FOQA data to be used to change procedures outside our organization [such as Air Traffic Control).* On the other hand, the FAA pilots operating under a FOQA program disagreed or strongly disagreed with the statement (74.4%) thereby producing a near mirror image of the GSA pilot sample on Item 12. Finally, both the FAA and GSA pilot samples were in similar agreement on Item 13 regarding their expectations of FOQA to positively impact operational safety (*I expect the FOQA program to positively impact the safety of our operations).*

01 FOQA is a program designed to enhance safety by identifying potential hazards before they result in an accident.

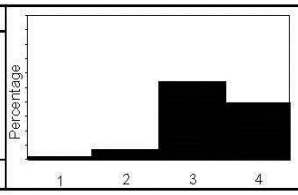
FAA Pilot Sample

Response	Frequency	Percent
1	0	0.0
2	5	5.0
3	48	48.0
4	47	47.0
Total	100	100.0



GSA Pilot Sample

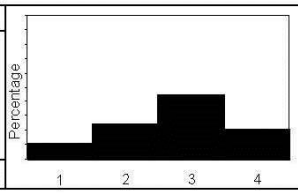
Response	Frequency	Percent
1	1	1.1
2	6	6.5
3	50	53.8
4	36	38.7
Total	93	100.0



04 Flying skills have improved or will improve with a FOQA program in place.

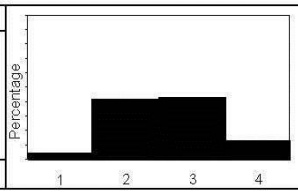
FAA Pilot Sample

Response	Frequency	Percent
1	10	10.6
2	23	24.5
3	42	44.7
4	19	20.2
Total	94	100.0



GSA Pilot Sample

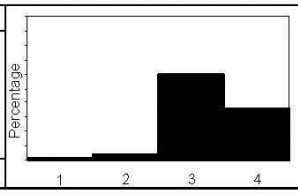
Response	Frequency	Percent
1	3	3.4
2	37	41.6
3	38	42.7
4	11	12.4
Total	89	100.0



06 I expect FOQA data to be used to take action to correct safety problems.

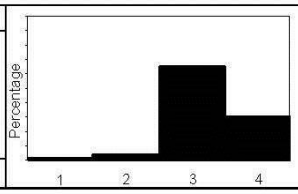
FAA Pilot Sample

Response	Frequency	Percent
1	1	1.0
2	4	4.1
3	58	59.2
4	35	35.7
Total	98	100.0



GSA Pilot Sample

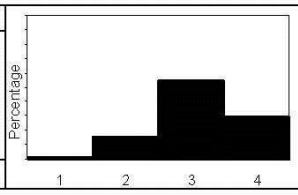
Response	Frequency	Percent
1	1	1.1
2	4	4.3
3	61	64.9
4	28	29.8
Total	94	100.0



07 I expect FOQA data to be used to improve pilot training.

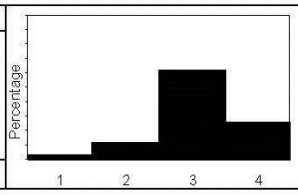
FAA Pilot Sample

Response	Frequency	Percent
1	1	1.0
2	15	15.3
3	53	54.1
4	29	29.6
Total	98	100.0



GSA Pilot Sample

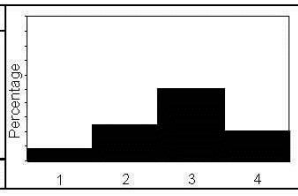
Response	Frequency	Percent
1	2	2.1
2	11	11.7
3	57	60.6
4	24	25.5
Total	94	100.0



08 I expect FOQA data to be used to optimize maintenance.

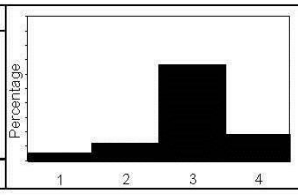
FAA Pilot Sample

Response	Frequency	Percent
1	6	7.1
2	20	23.8
3	41	48.8
4	17	20.2
Total	84	100.0



GSA Pilot Sample

Response	Frequency	Percent
1	5	5.5
2	10	11.0
3	60	65.9
4	16	17.6
Total	91	100.0



Note: Individual items were coded 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree

Figure 4. Positive Perceptions Scale Comparison

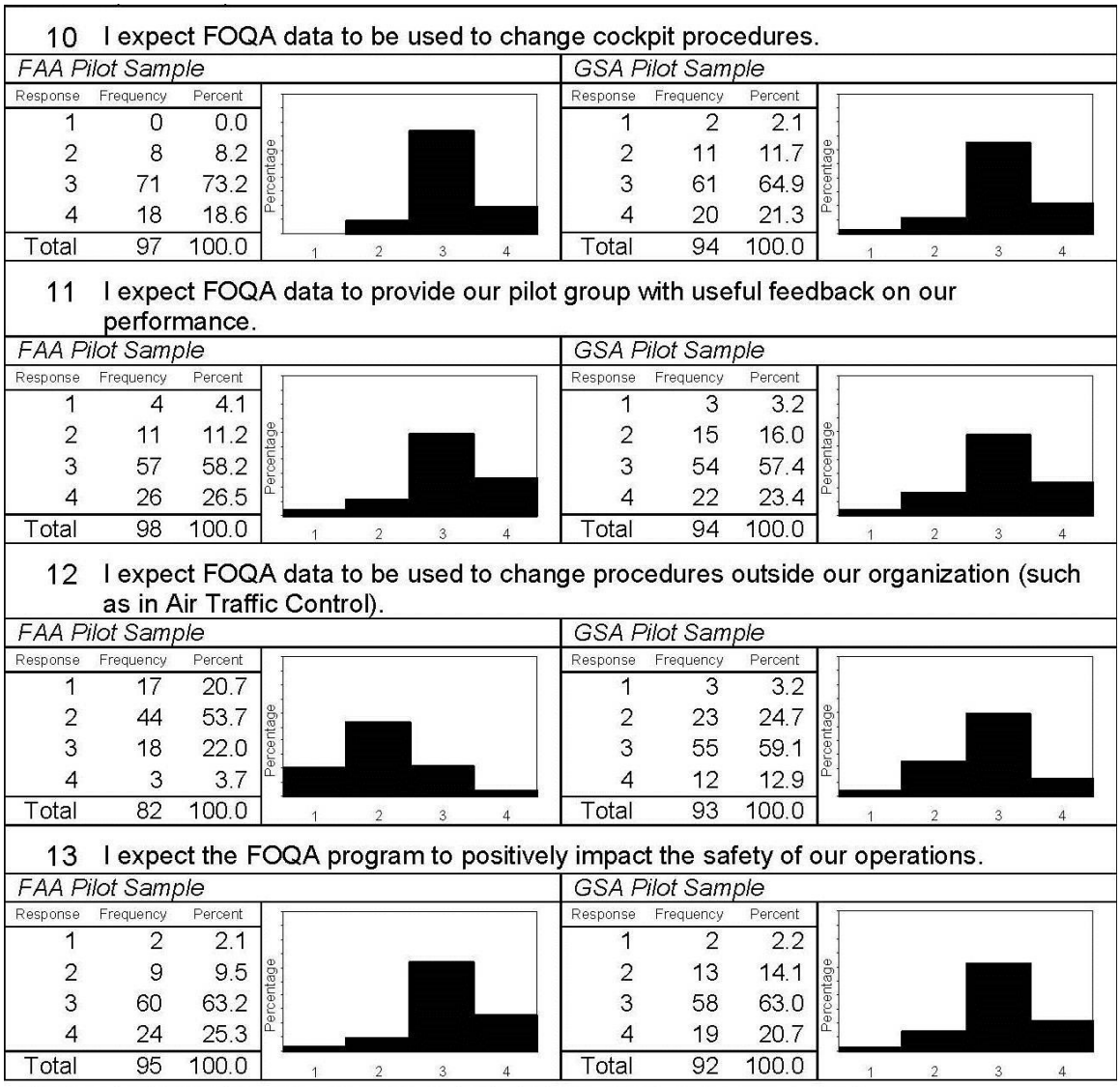


Figure 4. Positive Perceptions Scale Comparison (continued.)

Frequency Distribution - Negative Perception Scale

As with the Positive Perceptions Scale, many of the response distributions of items associated with the Negative Perceptions Scale had similarity between the FAA and GSA pilot samples as shown in the Figure 5 (*Negative Perceptions Scale Comparison).* The FAA has authority to take

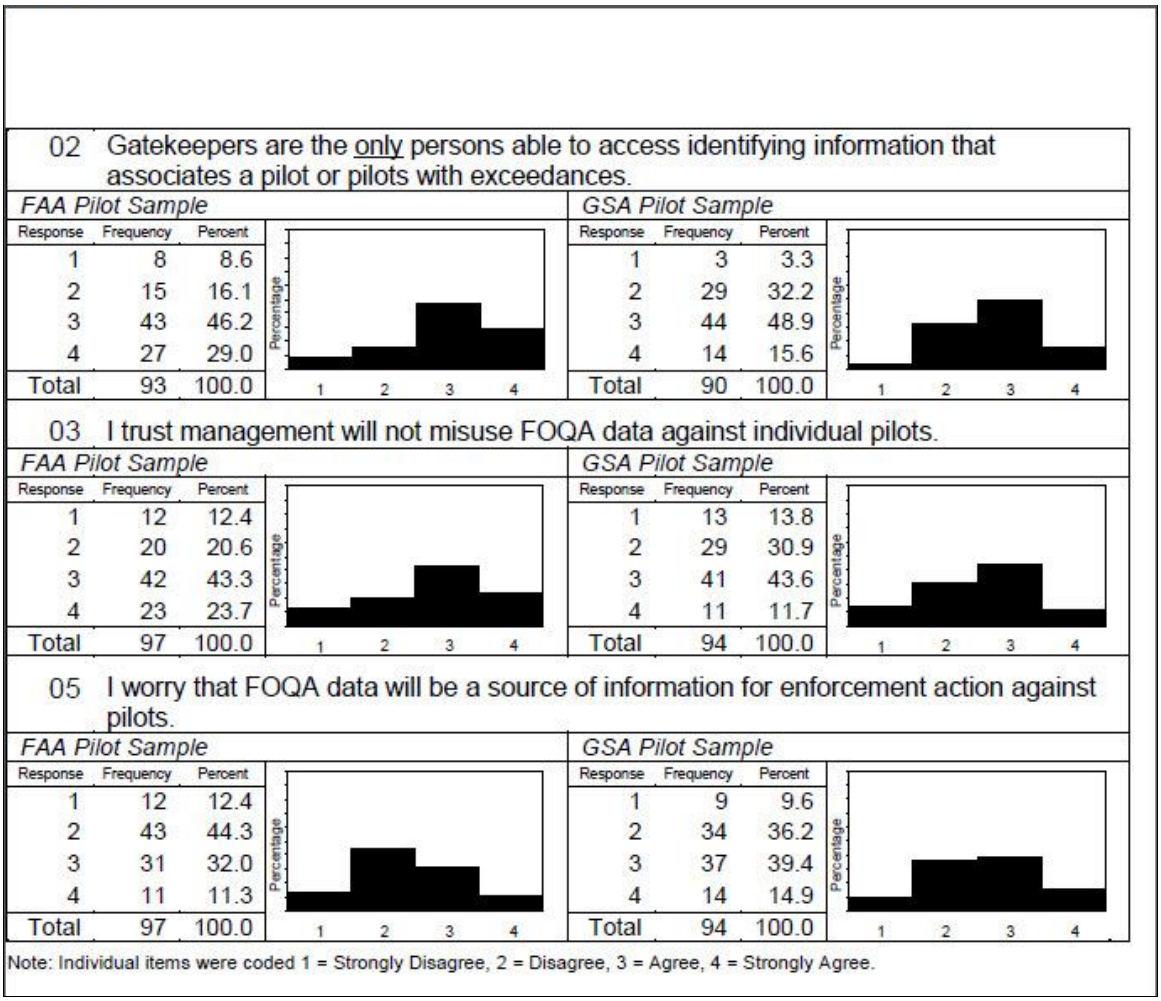
enforcement action against pilots for non-compliance with federal regulations and/or non-compliance with approved company safe operating procedures which can result in fines and/or suspension or revocation of a pilot certificate. For a commercial pilot, the result can be the removal of the pilot's livelihood. Both pilot samples (FAA and GSA) seemed to be worried that FOQA data would be used as a source of information for FAA to process regulatory violation actions against them. Specifically, over 43% of the FAA pilots agreed or strongly agreed with Item 5 (*I worry that FOQA data will be a source of information for enforcement action against pilots),* while 54% of the GSA pilot sample agreed or strongly agreed with it.

Management's access to FOQA data which collects individual pilot performance data can also be a concern for pilots. Item 3 addressed this issue - *I trust management will not misuse FOQA data against individual pilots.* The response results from both samples were similar. Specifically, the 55.3% of the GSA pilot sample agreed or strongly agreed with Item 3, while 67.0% of the FAA pilots agreed or strongly agreed with the statement.

Item 9 was more specific regarding pilot concerns about management's potential misuse of FOQA data (*I worry that FOQA data will be used for disciplinary actions*). A similar response pattern between the FAA and GSA samples was reported on Item 9. The GSA pilot sample expressed agreement or strong agreement (58.1%), while the FAA pilot sample reported a 44.2% agreement or strong agreement with the concern that FOQA data would be used for disciplinary actions.

Pilot concerns of FOQA data being released during civil litigation was addressed in Item 16 (*I worry that FOQA data could be released through civil litigation*). The responses from both pilot samples were nearly identical – FAA (72.8%), GSA (73.9%). Finally, FOQA's automatic

continuous monitoring of pilot performance and its subsequent actual or potential negative impact on pilot morale was assessed in Item 14 (*A FOQA program has negatively impacted, or will negatively impact, the morale of our pilots)*. The GSA and FAA pilot samples were also nearly identical in their response to this item indicating their agreement or strong agreement (30.7% and 30.1% respectively).



02 Gatekeepers are the only persons able to access identifying information that associates a pilot or pilots with exceedances.

FAA Pilot Sample

Response	Frequency	Percent
1	8	8.6
2	15	16.1
3	43	46.2
4	27	29.0
Total	93	100.0

GSA Pilot Sample

Response	Frequency	Percent
1	3	3.3
2	29	32.2
3	44	48.9
4	14	15.6
Total	90	100.0

03 I trust management will not misuse FOQA data against individual pilots.

FAA Pilot Sample

Response	Frequency	Percent
1	12	12.4
2	20	20.6
3	42	43.3
4	23	23.7
Total	97	100.0

GSA Pilot Sample

Response	Frequency	Percent
1	13	13.8
2	29	30.9
3	41	43.6
4	11	11.7
Total	94	100.0

05 I worry that FOQA data will be a source of information for enforcement action against pilots.

FAA Pilot Sample

Response	Frequency	Percent
1	12	12.4
2	43	44.3
3	31	32.0
4	11	11.3
Total	97	100.0

GSA Pilot Sample

Response	Frequency	Percent
1	9	9.6
2	34	36.2
3	37	39.4
4	14	14.9
Total	94	100.0

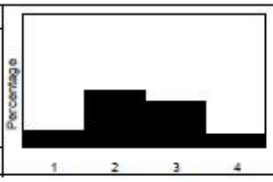
Note: Individual items were coded 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree.

Figure 5. Negative Perceptions Scale Comparison

09 I worry that FOQA data will be used for disciplinary actions.

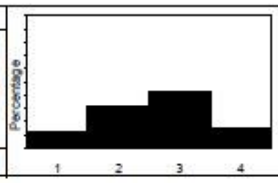
FAA Pilot Sample

Response	Frequency	Percent
1	12	12.6
2	41	43.2
3	33	34.7
4	9	9.5
Total	95	100.0



GSA Pilot Sample

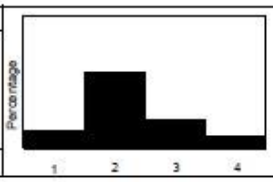
Response	Frequency	Percent
1	10	10.8
2	29	31.2
3	40	43.0
4	14	15.1
Total	93	100.0



14 A FOQA program has negatively impacted, or will negatively impact, the morale of our pilots.

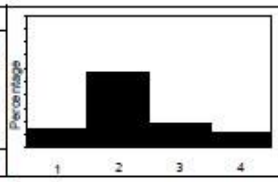
FAA Pilot Sample

Response	Frequency	Percent
1	12	12.9
2	53	57.0
3	20	21.5
4	8	8.6
Total	93	100.0



GSA Pilot Sample

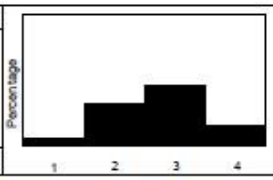
Response	Frequency	Percent
1	12	13.6
2	49	55.7
3	17	19.3
4	10	11.4
Total	88	100.0



15 I worry that FOQA data could be released under the Freedom of Information Act.

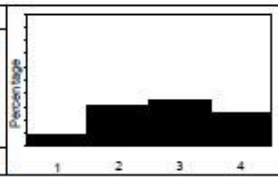
FAA Pilot Sample

Response	Frequency	Percent
1	6	6.9
2	28	32.2
3	40	46.0
4	13	14.9
Total	87	100.0



GSA Pilot Sample

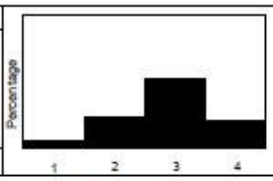
Response	Frequency	Percent
1	8	8.8
2	28	30.8
3	32	35.2
4	23	25.3
Total	91	100.0



16 I worry that FOQA data could be released through civil litigation.

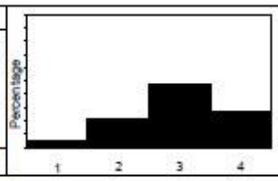
FAA Pilot Sample

Response	Frequency	Percent
1	4	4.5
2	20	22.7
3	46	52.3
4	18	20.5
Total	88	100.0



GSA Pilot Sample

Response	Frequency	Percent
1	5	5.4
2	19	20.7
3	44	47.8
4	24	26.1
Total	92	100.0



Note: Individual items were coded 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree.

Figure 5. Negative Perceptions Scale Comparison (continued)

The means and standard deviations from both samples on both the Positive and Negative Perceptions Scales were fairly similar as seen in Table 7 (*Summary of the Means and Standard Deviations by Pilot Sample*).

Table 7.

Summary of Means and Standard Deviations by Pilot Sample

	Group	N	M	SD
Positive Perceptions Scale	FAA	95	3.00	.48
	GSA	92	3.01	.52
Negative Perceptions Scale	FAA	95	2.41	.64
	GSA	92	2.56	.69

Inferential Statistics

Research Question 1

Research Question 1 hypothesized that pilots flying under a FOQA program (FAA pilot sample) would have more positive perceptions of FOQA than their counterparts who were not flying under a FOQA program.

A *t*-test was performed and confirmed that there were no significant differences between public sector pilots flying under a FOQA program (FAA sample) and those pilots not flying under a FOQA program (GSA sample) on the Positive Perceptions Scale (t (185) = .24; p=.81). Therefore, the null hypothesis for this research question was accepted and there are no

significant differences between the positive perceptions of federal public sector pilots flying with a FOQA program and their counterparts not flying under a FOQA program.

Research Question 2

Research Question 2 hypothesized that pilots flying without a FOQA program (GSA sample) would have more Negative Perceptions Scale scores than their counterparts flying with a FOQA program (FAA sample). Both groups had similar mean scores on the negative perceptions scale (FAA 2.41, GSA 2.56). A *t*-test was performed and confirmed that there were no significant differences between FAA pilots flying under a FOQA program and those pilots not flying under a FOQA program on the Negative Perceptions Scale ($t(185)= 1.56$; $p=.12$). Therefore the null hypothesis for this research question was accepted and there are no significant differences between the negative perceptions of federal public sector pilots flying without a FOQA program and their counterparts flying with a FOQA program.

Research Question 3

Research Question 3 determined if there was any relationship between pilot education levels and their perceptions of FOQA. The two groups (FAA pilots and GSA pilots) were compared on the one independent variable (level of education) which was gathered using the PFOQA survey instrument. One-way analysis of variance (ANOVA) was used to test the null hypothesis that education level has no relationship with either Positive or Negative Perceptions scale scores.

The PFOQA survey enabled each respondent to report seven different education levels; however the survey results had to be combined due to insufficient cell frequencies in four of the seven categories (i.e., Less than high school, high school diploma, some college, and Associate or two-year degree). Thus, the summary statistics contained inTable 8, (*Summary of Means and*

Standard Deviations for Positive and Negative Perceptions Scale Scores by Education Level), reflect this revision i.e., four instead of seven educational categories.

Table 8.

Summary of Means and Standard Deviations by Education Level

Education		Positive Perceptions		Negative Perceptions	
	N	**M**	**SD**	**M**	**SD**
Less than high school, high school diploma, some college, Associate or two-year degree	44	3.09	.52	2.43	.70
Bachelor's degree	45	3.00	.49	2.37	.56
Some graduate education	38	2.94	.46	2.62	.80
Graduate degree	55	3.04	.46	2.51	.64

The results of one-way ANOVA indicated that education level was not related to Positive Perceptions scale $F(3.178) = .69$, $p=.56$, but the ANOVA did reveal that the F ratio slightly exceeded 1 on the Negative Perceptions Scale($F(3.179) = 1.04$; $p=.38$); however statistical significance was not reached. Therefore, the null hypothesis for this research question was accepted and there is no relationship between federal public sector pilot education levels and positive or negative perceptions of FOQA.

Research Question 4

This research question hypothesized that pilots with FOQA experience would have higher Positive Perceptions Scale scores than pilots without FOQA experience. The researcher

attempted to compare the Positive Perception scales with the reported demographic variable indicating the degree of the pilot's experience with FOQA. Unfortunately missing values precluded this analysis because the total sample was reduced (N = 144), and the distribution of the variable was decidedly non-normal. Deletion of the outliers failed to correct the departures from normality primarily due to the large subset that had no experience with FOQA thereby rendering this variable unsuitable for parametric analysis. In addition, the number of ties also made this variable unsuitable for most non-parametric rank order alternative analysis. The researcher dichotomized the experience variable (i.e., 0 = No FOQA experience, 1 = FOQA experience) to enable analysis using the Pearson Product-Moment Correlation point-biserial correlation.

As shown Table____, *Summary of Means and Standard Deviations for Positive and Negative Perceptions Scale Scores by Total Participation*, pilots with FOQA experience had slightly higher Positive Perceptions Scale scores than those without FOQA experience. The one-tailed point-biserial correlation indicated that there was no reliable relationship between the Positive Perceptions scale and FOQA experience ($r_{pb}(142) = .09$; $p = .14$). Therefore, the null hypothesis for this research question was accepted and there is no relationship between positive public sector pilot perceptions of FOQA and the amount of time spent (experience) in a FOQA program.

Research Question 5

This research question hypothesized that pilots with FOQA experience would have lower Negative Perceptions Scale scores than pilots without FOQA experience. As shown in Table 9 (*Summary of Means and Standard Deviations by Total Participation*), pilots with FOQA

experience had lower Negative Perceptions Scale scores than those without FOQA experience. The one-tailed point-biserial correlation indicated that there was an association between lower Negative Perceptions Scale scores and FOQA experience ($r_{pb}(142) = -.16$; $p = .03$). Although an association exists, the association is extremely small and thus has little practical importance. Therefore the null hypothesis for this research question was accepted and there is no relationship between negative public sector pilot perceptions of FOQA and the amount of time spent (experience) in a FOQA program.

Table 9.

Summary of Means and Standard Deviations by Total Participation

	Group	N	M	SD
Positive Perceptions Scale	No FOQA experience	54	3.00	.43
	FOQA experience	90	3.09	.50
Negative Perceptions Scale	No FOQA experience	54	2.59	.67
	FOQA experience	90	2.37	.65

CHAPTER V

CONCLUSION

Summary

The American Management Association reported in 2007 that 82% of the managers surveyed used some type of electronic monitoring system to ascertain employee performance; however privacy issues, misuse and inappropriate release of electronic data were common potential employee concerns (Papini, 2007). Flight Operational Quality Assurance Programs (FOQA) electronically monitor pilot performance and provide air operators the ability to continuously and routinely digitally record aircraft operational data that can be used to recreate any flight for playback and future analysis. FOQA playback enables a three-dimensional time sequenced view of aircraft movements, cockpit instruments and switch positions in synchronization with the pilot's movement of flight controls and power levers. Thus, FOQA provides a robust objective picture of pilot performance.

Safety and economic performance has improved within air carriers that have implemented FOQA programs. For example, FOQA data have uncovered pilots flying high speed approaches contrary to safe operating procedures, and/or the airline's approved operations manual, which can lead to runway excursions on wet or slippery

runways and excessive wear on the aircraft's tires and brakes (Lacagnina & Rosenkrans, 1998). Electronic monitoring of pilot performance through FOQA has also been economically advantageous by preventing aircraft from being removed from revenue service when it otherwise would be required. For example, when a pilot exceeds the maximum engine temperature limitations on a FOQA equipped aircraft the actual temperature and duration of the excursion is recorded and available to maintenance personnel. Without FOQA, maintenance personnel must rely upon a pilot's subjective recollection and subsequent hand written recordings in the aircraft's maintenance logbook which results in increased aircraft downtime and potentially needless component removal and replacement. Not surprisingly, FOQA programs have been enthusiastically endorsed by the United States Congress, the Federal Aviation Administration (FAA), and the International Civil Aviation Organization (ICAO). On the other hand, only 35% of the large air carriers and 17% of small air carriers had a FOQA program as of January 2011, and negative pilot perceptions have been alleged by the U.S. Government Accountability Office (GAO) and others to be one of the primary barriers to the expansion of this important voluntary safety program (U.S. Government Accountability Office, 1997, 2010; Federal Aviation Administration, 2011a).

Little is known about pilot perceptions of being electronically monitored by FOQA. No survey had been conducted prior to this study, nor was a valid and reliable survey instrument available for gathering pilot perceptions prior to April 2011. This was the first research study using the newly developed sixteen item questionnaire known as the PFOQA survey instrument which was co-authored by Dr. Thomas R. Chidester, Manager of the FAA Aerospace Human Factors Research Division, and Mr. Thomas C. Accardi, former Director of FAA Aviation System Standards (Pfleiderer & Chidester, 2011, p. 1). The instrument elicits a pilots' level of

agreement with nine positive and seven negative items about FOQA programs reported on a four point Likert scale (Strongly Agree, Agree, Disagree, and Strongly Disagree) – a format widely recognized as one of the best for collecting information about attitudes Nunnally, 1978" (as cited in Pfleiderer & Chidester, 2011, p. 1). This research compared two independent samples of public sector pilot perceptions of FOQA – one operating with a FOQA program (FAA sample) and the other without a FOQA program (GSA sample). In addition, relationships between FOQA perceptions and two demographic variables (education and FOQA experience) were studied.

During 2010/2011, there were 396 public sector pilots operating aircraft in flight including border patrol, forest fires fighting and weather data gathering; however the FAA flight inspection organization responsible for the calibration of navigational equipment was the only federal agency operating aircraft with a FOQA program. This FAA pilot group (188 pilots) was used for an independent sample (FAA survey), while the remaining public sector pilots (n=208) operating without a FOQA program constituted the second independent sample (GSA survey) for comparative research purposes. Response rates were 56% and 46% respectively on the FAA and GSA surveys.

This research hypothesized that pilots flying under a FOQA program would have more positive perceptions, and lower negative perceptions, of FOQA than their counterparts not flying under a FOQA program. No significant differences between the two independent samples were found on either the positive or negative PFOQA perceptions scale and the null hypothesis was accepted on both research questions one and two.

This researcher also sought to ascertain if there was any relationship between pilot education levels and positive or negative FOQA perceptions. The research did not find any

significant relationship between educational levels and perceptions of FOQA on either the positive or negative perception scales. The null hypothesis was accepted on research question three.

This research hypothesized that pilots with FOQA experience would have higher positive perception scale scores, and lower negative perception scale scores, than pilots operating without FOQA experience. No statistically significant difference was found between pilots with FOQA experience vs. those without on the positive perceptions scale. Pilots with FOQA experience had significantly lower negative perceptions of FOQA than pilots without FOQA experience; however, this relationship was too small to have any practical importance and the null hypothesis was accepted on both research questions four and five.

Conclusions

The safety and economic benefits of FOQA have been thoroughly established in large U.S. air carriers since its early beginnings over a half century ago with British Airways and TAP Air Portugal in the early 1960's (Lacagnina & Rosenkrans, 2004). FOQA is a unique contributor to aviation safety because it provides objective quantitative data on actual flight operations, rather than what has traditionally been available from subjective human observations of flight crew performance. The U.S. implementation of FOQA has not taken root throughout all sectors of the United States aviation industry despite the availability and reduced cost of data recording technologies and FAA's active promotion of FOQA as a voluntary program for nearly two decades. The FAA reported that FOQA has been voluntarily adopted by 44% (41 of 93) of the large air carriers in the U.S. as of November 5, 2010 (Federal Aviation Administration, 2010),

but that number had declined to 35% by January 2011 (Federal Aviation Administration, 2011a). Thus, not only have small air operators ignored the safety benefits of FOQA, but more troubling, the number of large U.S. air carriers voluntarily participating is declining. Effective safety risk management requires data gathering, consolidation, analysis and assessment of relevant safety information. Without broader FOQA adoption, robust consolidated safety information systems will not develop to support aviation safety risk management models to identify incident and accident precursors that are needed by both large and small air operators and the FAA.

Negative perceptions by pilots of FOQA's electronic monitoring have been alleged to be a barrier and reason for air operators to not adopt FOQA as part of their safety assurance programs (Flight Safety Foundation, 1992; U.S. GAO, 1997, 2010). The United States General Accountability Office has maintained that one reason for the reluctance of operators to adopt FOQA was due to negative pilot perceptions of it (U.S. Government Accountability Office, 1997, 2010). This research has found no significant differences in public sector pilot perceptions of FOQA between those operators with a FOQA program and those without, and thus negative pilot perceptions are probably not a major reason for small public sector operators' failure to adopt a voluntary FOQA program.

All pilots receive many different types of monitoring throughout their flying career by check airman, FAA inspectors and training department evaluators, etc. These systems provide limited insights into the overall safety performance of the air operator. Aiello and Kolb (1995) found that individual electronic monitoring systems were less likely to be accepted by employees than broader monitoring systems. Grant & Higgins (1987) also found routine vs. occasional electronic monitoring was found to lead to increased perceptions of fairness. FOQA provides broad routine monitoring of pilot performance with objective continuous routine electronic

recording capabilities. The findings of this research on public sector pilot perceptions of electronic monitoring by FOQA are consistent with the findings of Grant & Higgins (1987) and the findings of Aiello & Kolb (1995).

This research implies that pilot fears and negative perceptions of FOQA may be mitigated after adoption of a FOQA program. The FAA pilot sample operating with a FOQA program had stronger trust in management not to misuse FOQA data than their counterparts not operating with a FOQA program (67% vs. 55.3%). In addition, there was less worry by the FAA pilots that FOQA data would be used for disciplinary actions (44.2% vs. 58.1%) suggesting that anticipated concerns and fears can probably be mitigated if trust can be maintained with the pilots after adoption of a FOQA program. The results of this research also indicate that FAA pilots operating with a FOQA program (FAA survey) demonstrated considerable faith in the confidentiality that a FOQA gatekeeper can provide. A designated gatekeeper is the only person with access to the pilot's association with a given flight, and thus the gatekeeper can perform the important role of maintaining pilot confidentiality. More than 75% of the FAA pilots surveyed agreed with Item 2 (*Gatekeepers are the only persons able to access identifying information that associates a pilot or pilots with exceedances*). Thus, the manner in which an air operators' management partners with the pilot union or employee representative organization to protect the confidentiality of individual pilots may be an important variable in the pilot's perceptions of informational justice and continued acceptance of FOQA. McNall & Roch (2009) found that electronic monitoring was positively related to perceptions of informational justice and Douthitt and Aiello (2001) and Alge (2001) found that monitored participants who were given the opportunity to voice their opinion about the design and implementation of the monitoring system had higher perceptions of procedural justice. Thus, the opportunity for pilot participation in the

design and implementation of a FOQA program may be an important variable in the initial and continued acceptance of FOQA by pilots. Finally, both pilot samples appeared to generally have confidence in the safety benefits of adopting a FOQA program because they both agreed, or strongly agreed, with the statement that adoption of a FOQA program would positively impact the safety of their organizations (GSA 88.7%; FAA 83.7%).

Worry that FOQA data would be released for use in civil litigation was a significant and almost identical concern within both the FAA and GSA pilot samples (72.8% and 73.9% respectively). Many new aircraft have hundreds of sensors and quick access flight data recorders (QAR's) installed as standard equipment enabling flight data analysis information to be readily available and accessible for management review of individual airman performance. In addition, this data is unprotected from release to outside organizations. Ironically, a pilot operating a modern aircraft for an operator without a FOQA program may be more vulnerable to flight data monitoring misuse than if the pilot were operating with a FOQA program because informational justice may be more difficult to obtain without the data protection provisions routinely afforded those operators with an FAA approved FOQA program. Clearly, the distinction between pilots operating under a FOQA program and those operating without one has become increasingly blurred due to the reduction in technology costs and the routine installation of electronic monitoring systems on modern aircraft of all sizes.

Large air operators are in the process of implementing Safety Management Systems (SMS) to identify and mitigate operational safety risks. FOQA can and should be a critical source of objective flight safety data enabling the expansion of organizational knowledge and aviation safety in general. Concurrently, adoption of FOQA can probably contribute to the development of improved organizational trust between management and the organizations' pilots

if FOQA data is properly managed and FOQA data gatekeepers representing pilots are properly integrated into the air operators' data protection plans and processes. This research may assist FAA regulators and other aviation industry trade groups in promoting voluntary adoption of FOQA, especially if subsequent research with other private sector pilot groups is found to be consistent with this research of federal public sector pilots.

Recommendations

The United States Federal Aviation Administration has been a global leader in aviation safety for decades, and the developing world continues to follow the lead of the United States in aviation safety. Safety risk management is a key component of global initiatives aimed at a continuous reduction of aviation's enviable safety record. ICAO mandated Safety Management Systems (SMS) for international operations in 2009 by requiring aircraft weighing in excess of 59,525 lbs. to establish and maintain a flight data analysis (FDA), or FOQA program. FAA has chosen to maintain FOQA as a voluntary program (Federal Aviation Administration, 2010a) for large air operations (operating under CFR 49, Federal Aviation Regulations Part 121) and has not proposed an SMS program for U.S. small air operators (operating under CFR 49, Federal Aviation Regulations Part 135).

The United States has obligations under the Convention on International Civil Aviation to either conform to ICAO Standards, or file a difference with ICAO by notifying other member States of the United States non-compliance with the adopted international ICAO standard. If FOQA becomes adopted by ICAO as a required part of the ICAO mandated Safety Management System (Amendment 30 Section 3.2 to Annex 6), the United States will be forced into adopting a

new mandatory FOQA requirement to conform with ICAO standards, or FAA will be required to file a difference with ICAO indicating the United States will remain out of compliance with ICAO's flight data analysis standard. If the Federal Aviation Administration choses to file a difference with ICAO, thereby disagreeing with the international commitment to make flight data analysis a requirement of the State's SMS program, the United States government will be sending a powerful negative signal to the global aviation community regarding it's opinion of the safety benefits of flight data analysis as a component of a robust safety management system. Finally, international small air operators of U.S. aircraft and/or large business jet operators in non-commercial carriage may find that they are increasingly detained in other countries for failure of the U.S. to comply with international standards, thereby causing adverse economic impact for the U.S. aviation industry and embarrassment for the global leader in aviation safety.

Recommendation 1

FAA should form a government/industry task force to promote FOQA adoption by small air operators to increase agency credibility with Congress and the aviation industry.

The United States Congress recognized the need for air carriers to implement safety management systems by passing the Airline Safety and Federal Aviation Administration Extension Act of 2010 known as Public Law 111-216. This public law requires the FAA to conduct rulemaking to require all CFR 49 FAR part 121 air carriers to implement a safety management system and *consider mandating existing voluntary safety programs such as FOQA* (italics added) (Airline Safety and Federal Aviation Extension Act, 2010). Safety Management Systems are supposed to be comprehensive, process-oriented approaches to managing safety throughout an organization. FAA's new proposed SMS regulations (CFR 14, Part 5.55 (a) and

5.71) will require organizations to develop and maintain processes to analyze safety risk and *maintain processes and systems to acquire data* (italics added) with respect to its operations, products and services (Federal Aviation Administration, 2011b), but these proposed regulations do not mandate a FOQA program as part of the operators safety management system to acquire safety data. Thus, FAA's SMS regulations could quickly become hollow if air operators do not voluntarily adopt FOQA as part of a comprehensive safety data gathering system to identify and mitigate organizational risk. Therefore, it is recommended that FAA initiate the development of a broad based industry led flight data analysis team of industry representatives to reenergize and promote the best practices in the initiation and operation of FOQA programs throughout all segments of the aviation industry, but especially in those segments that have shunned voluntary adoption. Acceptance of this recommendation should result in the FAA being better prepared to address and demonstrate the FAA's compliance with the Congressional intent of Public Law 111-216, section 215 and put substance into the proposed data analysis requirements of FAA's proposed SMS regulations.

Recommendation 2

FAA should submit to Congress proposed language to be included in FAA's FY15 budget that would protect sensitive aviation information (FOQA) from litigation discovery.

Congress did not create a statutory privilege for FOQA, and thus the United States Magistrate Judge in the Eastern District of Kentucky chose to release voluntarily generated safety reports to litigants in a wrongful death lawsuit. The potential for civil and/or criminal suits against individual pilots exists. The prosecution of the pilots of an Airbus A320 that crashed in Habsheim, France during an airshow in June 1988 relied heavily on the flight data analysis

(FDA) data. The captain was sentenced to six months in prison (Mateou & Mateou, 2010). This research found that pilots with and without FOQA programs were worried about the release of FOQA data in civil litigation. FAA's data protection provisions outlined in Federal Regulation Part 193 does nothing to address this concern. In fact, the regulation enables public disclosure of FOQA data to carry out a criminal investigation or prosecution (Comair's motion for a protective order…, 2008). Therefore, FAA should demonstrate support for the sanctity of voluntary safety data gathering programs, such as FOQA, by requesting Congress to enact legislation that expressly prohibits its release during the discovery process of civil litigation. Congress protected cockpit voice recorder transcripts from discovery by litigants, and thus there is a relevant precedent (Comair's motion for a protective order…2008). FAA's request to Congress will demonstrate the agencies' commitment to the protection of FOQA data and will likely engender industry trust, credibility and support for further adoption of FOQA.

Recommendation 3

The FAA should reconsider the long standing position that FOQA should be a voluntary safety program for all United States air operators by convening an Aviation Rulemaking Advisory Committee (ARAC) to review FAA's existing policy and make recommendations for potential future rulemaking.

The international aviation community is composed of 188 contracting states of the International Civil Aviation Organization (ICAO). ICAO has had a requirement since 2005 requiring all aircraft operating internationally (weighing in excess of 59,525 lbs.) to establish and maintain a flight data analysis (FDA) or FOQA program. ICAO Annex 6, Part 1, Section 3.2 also recommends that a flight data analysis program be implemented for all aircraft weighing less

than 44,093 lbs. Although this has been an ICAO international standard and recommended practice for nearly a decade, FAA has chosen to maintain FOQA as a voluntary program (Federal Aviation Administration, 2010a). After nearly two decades, it is time to formally revisit FAA's FOQA policy because FOQA has lost momentum in the United States.

The creation of an ARAC to address FAA's current voluntary FOQA policy will demonstrate FAA's compliance with the Airline Safety and Federal Aviation Administration Extension Act of 2010 known as Public Law 111-216 which requires the FAA to *consider mandating existing voluntary safety programs such as FOQA* (italics added) (Airline Safety and Federal Aviation Extension Act, 2010). In addition, by creating an ARAC, FAA will enable industry to submit recommendations for consideration in rulemaking without committing itself to amendment of the current voluntary FOQA policy.

Recommendation 4

Senior leaders of aviation organizations should seriously consider adopting FOQA as a component of their safety program to reduce their potential personal and corporate liability.

A corporate accident is defined as "one whose ultimate root cause can be traced back to a failure of corporate systems" (Whittingham, 2008, p. 1). Civil and criminal inquiries into corporate accidents have revealed poor, or non-existent management controls, or defective management systems, as the most common root cause of a corporate accident (Whittingham, 2008, p. 176). The FAA's proposed SMS regulation requires the designation of an executive who is accountable and responsible with the final authority for the safety performance of the organization. It also requires the development of systems to acquire data to monitor organizational safety performance (Federal Aviation Administration, 2011b). Thus, aviation

leaders may find themselves the subject of civil litigation by not implementing FOQA programs that might have identified risk and precursors of serious incidents or accidents involving death or injury, and subsequently be charged with defective management systems that were not in compliance with the international safety standards and the expectations of a reasonable and prudent aviation executive committed to the highest levels of aviation safety.

Recommendation 5

FAA should initiate an industry research agenda to ascertain the barriers perceived by small operators to adopting FOQA.

This researcher has concluded that public sector pilot perceptions of FOQA are an appropriate area of research. Pilot concerns were very similar across the public sector pilot community regardless of whether or not they operated with or without a FOQA program, or whether the individual pilot had FOQA experience. This research was the first research conducted on pilot perceptions of FOQA, but it was confined to federal public sector pilots. The FAA should conduct further research on barriers perceived by other pilot groups in the private sector. Additional research is needed to broaden the base of pilot perceptions of FOQA beyond the federal public sector pilot community to ascertain if the same or different perceptions of FOQA are present.

Recommendation 6

Qualitative research should be conducted with air operators who have voluntarily adopted a FOQA program.

Large air carriers who have adopted FOQA programs over the past two decades have probably developed methods to mitigate pilot concerns about being electronically monitored by FOQA. Qualitative research should be conducted through standardized structured interviews to ascertain the methods used by management at air operators with FOQA programs. For example, management can develop policies and corporate practices that provide pilot confidentiality by establishing trusted FOQA gatekeepers, or management can chose to use FOQA data to investigate, discipline and/or intimidate its employees. Qualitative research focused upon developing an understanding of managements' attitudes about FOQA would be an important complement to this research. This research found that 67% of the pilots operating under a FOQA program (FAA sample) had trust that management would not misuse FOQA data against individual pilots. Therefore, it is recommended that qualitative research be conducted with management officials at air operators with a FOQA program to ascertain the specific issues and mitigation strategies used to engender trust and continued acceptance of being electronically monitored by FOQA. Finally, a qualitative study could ultimately lead to a compendium of best FOQA practices that could be available to both the FAA and the aviation industry to promote voluntary FOQA adoption by small air operators.

Public sector small air operators operate in a variety of environments that pose risk to safe operations. FAA's promotion of safety data analysis by air operators through voluntary adoption of FOQA has stalled. FOQA has not been accepted by the small air operator sector for nearly two decades. This research has found few differences in perceptions of FOQA within the public sector pilot community, and thus pilot perceptions do not appear to be a barrier to voluntary adoption of FOQA, at least within the federal public sector. FAA should formally engage the aviation industry and publically recommit to FOQA as a key component of a robust

safety management system. If FAA desires to retain global leadership in flight data analysis and safety risk management, they should initiate new action to reenergize broader adoption of FOQA.

REFERENCES

Aiello, J. & Kolb, K. (1995). Electronic performance monitoring and social context: impact on productivity and stress. *Journal of Applied Psychology,* 80, 339-353.

Airline Safety and Federal Aviation Administration Extension Act. (2010). 49 U.S.C. 44701. Public Law No. 111-216.

Alder, G. S. (2001). Employee reactions to electronic performance monitoring: A consequence of organizational culture. *The Journal of High Technology Management Research, 12,* 323-342.

Alge, B. (2001). Effects of computer surveillance on perceptions of privacy and procedural justice. *Journal of Applied Psychology*, 86, 797-804.

Barbbie, E. (1990). *Survey research methods.* Belmont: Wadsworth, Inc.

Comair's motion for a protective order and motion to quash deposition (January 17, 2008, [DE#1200]), Case 5:06-cv-00316-KSF, (Eastern District of Kentucky).

Creswell, J.W. (2008). *Educational research, planning, conducting, and evaluating quantitative and qualitative research*, (3rd ed.). Upper Saddle River, Pearson Prentice Hall.

Dekker, S. W. (2009), Prosecuting professional mistake: Secondary victimization and a research agenda for criminology. *International Journal of Criminal Justice Sciences.* 4 (1), 60-78. Retrieved from: http://www.sascv.org/ijcjs/dekkerijcjs2009.pdf.

Dirks, K.T., & Ferrin, D.L. (2002). Trust in leadership: Meta-analytic findings and implications for research and practice. *Journal of Applied Psychology,* 87, 611-628.

Douthitt, E.A., & Aiello, J.R. (2001). The role of participation and control in the effects of computer monitoring on fairness perceptions, task satisfaction, and performance. *Journal of Applied Psychology,* 86, 867-874.

FAA's oversight of on-demand aircraft operations: Hearing before the House Committee on Transportation and Infrastructure, House of Representatives, 112th Cong. 2 (2010) (testimony of Peggy Gilligan, Associate Administrator for Aviation Safety). Retrieved from: www.faa.gov/news/testimony/news_story.cfm?newsId=11252

Federal Aviation Administration. (February 9, 1995). *Aviation safety action plan: Zero accidents…A Shared Responsibility.*

Federal Aviation Administration. (2001). *Protection of Voluntarily Submitted Information Rule*. (14 C.F.R. Part 193.9 (a) 2). Retrieved from: http://www.ecfr.gov/cgi-bin/text

Federal Aviation Administration. (April 14, 2003), *Designation of flight operational quality assurance (FOQA) information as protected from public disclosure under 14 CFR Part 193.* (Notice 8000.81), Initiated by: AFS-230.

Federal Aviation Administration. (September 30, 2008), *National policy, safety management system guidance.* (Order 8000.369), Initiated by: AVS-1.

Federal Aviation Administration. (July 23, 2009), *Safety Management System.* (Federal Register Vol. 74, No. 140), p. 36414.

Federal Aviation Administration. (2010). *Answering the call to action on airline safety and pilot training* (Report No. HQ 101038).

Federal Aviation Administration. (*n.d.), Safety management systems for aviation service providers* (Advisory Circular AC No: 120-92B). Initiated by: AFS-900, Unpublished undated draft material.

Federal Aviation Administration. (August 30, 2010a). *National policy safety management systems update* (Notice 8900.133). Initiated by: AFS-900.

Federal Aviation Administration. (November 5, 2010b). *Safety management system* (Federal Register Vol. 75, No. 214), pp. 68224-68245,.

Federal Aviation Administration. (2011). *Aviation system standards, flight operational quality assurance program review, 2011*. Unpublished raw data.

Federal Aviation Administration. (2011a). *Voluntary safety programs response to P.L. 111-216, Section 213.* Unpublished.

Federal Aviation Administration. (2011b). *Safety management systems for certificate holders operating under 14 CFR part 121, 14 CFR Parts 5*. (Docket No. FAA-2009-0671). Unpublished Pre-decisional draft, Notice No. 10- RIN 2120-AJ86.

Federal Aviation Administration. (2013). *Aerospace forecast fiscal years 2013 -203.* Retrieved from:http://www.faa.gov/about/office_org/headquarters_offices/apl/aviation_forecasts/aerospace_forecasts/2013-2033/media/2013_Forecast.pdf .

Fernandes, R. V. (2002). *An analysis of the potential benefits to airlines of flight data monitoring programmes* (Unpublished master's thesis). Cranfield University, Cranfield, United Kingdom.

Flight Safety Foundation. (1992). *Air carrier voluntary flight operational quality assurance program,* Prepared under contract to the Federal Aviation Administration, Contract No. DTFA01-92-C-00010.

Flight Safety Foundation. (1998, July-September). Pilot union encourages use of FOQA programs. *Flight Safety Digest*, 17(7-9), 8-10.

Flottau, J., & Wall, R. (December, 10, 2010). Legal limits ten years after the Air France concorde crash, a French court blames continental. *Aviation Week & Space Technology*, 37-39.

Gay, L.R. & Airasian, P. (2000). *Educational research competencies for analysis and application* (6th ed.). New Jersey: Prentice-Hall.

Gay, L.R., Mills, G.E. & Airasian, P. (2006). *Educational research competencies for analysis and application* (8th ed.). New Jersey: Prentice- Hall.

Grant, R. & Higgins C. (1987). Monitoring service workers via computer: The effect on employees, productivity, and service. *National Productivity Review,* 8(2), 101-112.

Halbwachs, M. (1950). *The Collective Memory* (M. Douglas, Trans.). New York: Harper Colophon Books.

Hogan, R. (2007). *Personality and the fate of organizations*. Mahwah: Lawrence Erlbaum Associates, Inc.

Holtom, M. (2000). Properly managed FOQA programme represents an important safety tool for airlines. *ICAO Journal, January/February 2000.*

Hubbard, D.W. (2009). *The failure of risk management.* New Jersey: John Wiley & Sons, Inc.

International Civil Aviation Organization (2001). Annex 13, Paragraph 5.12.

International Civil Aviation Organization (2009). *Safety management manual*, (Doc 9859 AN/474).

Kaste, M. (Producer). (October 28, 2009). *Digital Bread Crumbs: Following Your Cell Phone Trail*, Retrieved from http://www.npr.org/templates/story/story.php?storyId=114241860.

Kidwell, R.E. & Bennett, N. (1994). Employee reactions to electronic control systems, The role of procedural fairness. *Group & Organization Manage*ment, 19(2), 203-218.

Lacagnina, M. & Rosenkrans, W. (Eds). (1998). Aviation Safety: U.S. Efforts To Implement Flight Operational Quality Assurance Programs. *Flight Safety Digest*, 17(7-9).

Lacagnina, M. & Rosenkrans, W. (Eds). (2004). Wealth of Guidance and Experience Encourage Wider Adoption of FOQA. *Flight Safety Digest*, 23(6-7).

Lacagnina, M. (2007, August). C-FOQA takes root, foundation introduces a powerful corporate aviation safety tool. *AeroSafety World*, 11-15.

Lowe, S. E., Pfleiderer, E.M, and Chidester, T.R. (2012). *Perceptions and efficacy of flight operational quality assurance (FOQA) programs among small-scale operators,* (DOT/FAA/AM-12-1).

Mateou, S.M. & Mateou, A. (2010). *Flying in the face of criminalization.* Burlington: Ashgate Publishing Company.

Mayer, R.C., Davis, J.H., & Schoorman, F.D., (2006). An integrative model of organizational trust. R.M. Kramer, (Ed), *Organizational Trust*, (pp. 82-108). New York: Oxford University Press.

McKenna, J. T. (December, 1998). Garvey policy backs limits on FOQA data. *Aviation Week and Space Technology*, 37.

McNall, L.A., & Roch, S.G. (2009). A social exchange model of employee reactions to electronic performance monitoring, *Human Performance*, 22, 204-224.

.

Papini, J. D. (2007). *Big brother: The effect of electronic employee monitoring on electronic misbehavior, job satisfaction, and organizational commitment.* (Unpublished doctoral dissertation). Alliant International University, Los Angeles, CA.

Pearce, J. L., & Klein, K. (January, 2010). *Employees' trust in their organizations: Does familiarity breed contempt?* Paper presented at the 5th workshop on trust within and

between organizations. The European Institute for Advanced Studies in Management, Madrid, Spain.

Pfleiderer, E. M. & Chidester, T. R. (2011). *Establishing the reliability and validity of the perceptions of flight operational quality assurance (PFOQA) questionnaire,* (DOT/FAA/AM-11/6).

Phillips, Don (1995, February 10). FAA, airlines agree on recorders, *The Washington Post*, pp. D3.

Reason, J. (1997). *Managing the risks of organizational accidents.* Burlington: Ashgate Publishing Company.

Reina, D.S. & Reina, M.L. (2006). *Trust and betrayal in the workplace.* San Francisco, Berrett-Koehler Publishers Inc.

Robinson, S.L. (2006). Trust and breach of the psychological contract. R.M. Kramer (Ed), *Organizational Trust,* (pp. 331-360). New York: Oxford University Press.

Safety board blames pilot for fatal USAir accident: Aviation officials say his failure to spot a rudder error caused the jet to skid into a N.Y. river. (1990, July 4). *Los Angeles Times* Retrieved from http://articles.latimes.com/1990-07-04/news/mn-103_1_safety-board.

Sheskin, D.J. (2007). *Handbook of parametric and nonparametric statistical procedures*. Boca Raton: Chapman & Hall.

Sparaco, P. (2010, December). Unfairly Judged, Concorde verdict merely underscores wider problems with accident investigations here. *Aviation Week & Space Technology*, 81

Stolzer, A. J. (2002). *Fuel consumption modeling of a transport category aircraft: A flight operations quality assurance (FOQA) analysis* (unpublished doctoral dissertation). Retrieved from: http://proquest.umi.com.ezproxy.osu-tulsa.okstate.edu/

Susser, P. A. (1988). Electronic monitoring in the private sector: How closely should employers supervise their workers? *Employee Relations Law Journal*, 13, 575-598.

The Federal Aviation Administration's oversight of on-demand aircraft operators: Hearing before the Aviation Subcommittee on Aviation on the Transportation and Infrastructure Committee, House of Representatives (testimony of Calvin L. Scovel, Inspector General U.S. Department of Transportation), March 17, 2010.

The trend toward's criminalization of aircraft accidents: Hearing before the Aviation Subcommittee of Aviation on the Transportation and Infrastructure Committee, House of Representatives (testimony of Paul McCarthy, Executive Air Safety Chairman, Airline Pilots Association), July 27, 2000, Retrieved from: http://cf.alpa.org/Internet/TM/tm072700.htm

Trautman, R., (1995, December 10). U.S. aviation experts see moves making skies safer. *Reuters News*. (12-10 0591).

U.S. Congress Office of Technology Assessment. (1987). *The electronic supervisor: New technology, new tensions,* (OTA-CIT-333). Washington, D.C.: Government Printing Office.

U.S. Department of Transportation, Office of the Inspector General. (2009). *FAA is not realizing the full benefits of the aviation safety action program,* (Report No. AV-2009-057). Washington, D.C.: Government Printing Office.

U.S. Government Accountability Office. (1991). *Aviation safety: Problems persist in FAA's inspection program* (Report No. GAO/RCED-92-14). Washington, D.C.: Government Printing Office.

U.S. Government Accountability Office (1995). *Data problems threaten FAA strides on safety analysis system* (Report No. GAO/AIMD-95-27). Washington, D.C.: Government Printing Office.

U.S. Government Accountability Office. (1997). *Aviation safety: Efforts to implement flight operational quality assurance programs*. (Report No. GAO/RCED-98-10). Washington, D.C.: Government Printing Office.

U.S. Government Accountability Office. (2004). *Federal aircraft, inaccurate cost data and weaknesses in fleet management planning hamper cost effective operations* (Report No. GAO/-04-645). Washington, D.C.: Government Printing Office.

U.S. Government Accountability Office. (2010). *Improved data quality and analysis capabilities are needed as FAA plans a risk-based approach to safety oversight.* (Report No. GA-10-414). Washington, D.C.: Government Printing Office.

U.S. National Transportation Safety Board (1996), *In-flight fire and impact with terrain, Valujet airlines flight 592, DC-9-32, N904VJ*. (NTSB/Aar-97/06 DCA96MA054). Washington, D.C.: Government Printing Office.

U.S. National Transportation Safety Board. (2009, September 24). [Letter to FAA Administrator Randolph Babbitt]. (Safety recommendations A-09-87 through -96), Washington, D.C.

Vaught, B. C., Taylor, R.E. & Vaught, S.F. (2000). The attitudes of managers regarding the electronic monitoring of employee behavior: Procedural and ethical considerations. *American Business Review*, 18(1), 107-114.

Velocci, A. (2008, March). Don't let courts trump safety. *Aviation Week and Space Technology*, 58.

Von Thaden, T.L., Wiegmann, D.A., & Shappell, S.A. (2011). Organizational factors in commercial aviation accidents. *The International Journal of Aviation Psychology,* 16(3), 239-261.

Wald, M. L.(1995, December 8) Experts note slow but steady progress on safety while flying. *New York Times*, pp. A29.

Walters, J.M. & Sumwalt III, R. (2000). *Aircraft accident analysis: Final reports*. New York: McGraw Hill.

Whitener, E.M., Brodt, S.E., Korsgaard, M.A., & Werner, J.M. (2006). Managers as initiators of trust: An exchange relationship framework for understanding managerial trustworthy behavior. R.M. Kramer, Ed., *Organizational Trust*, New York: Oxford University Press.

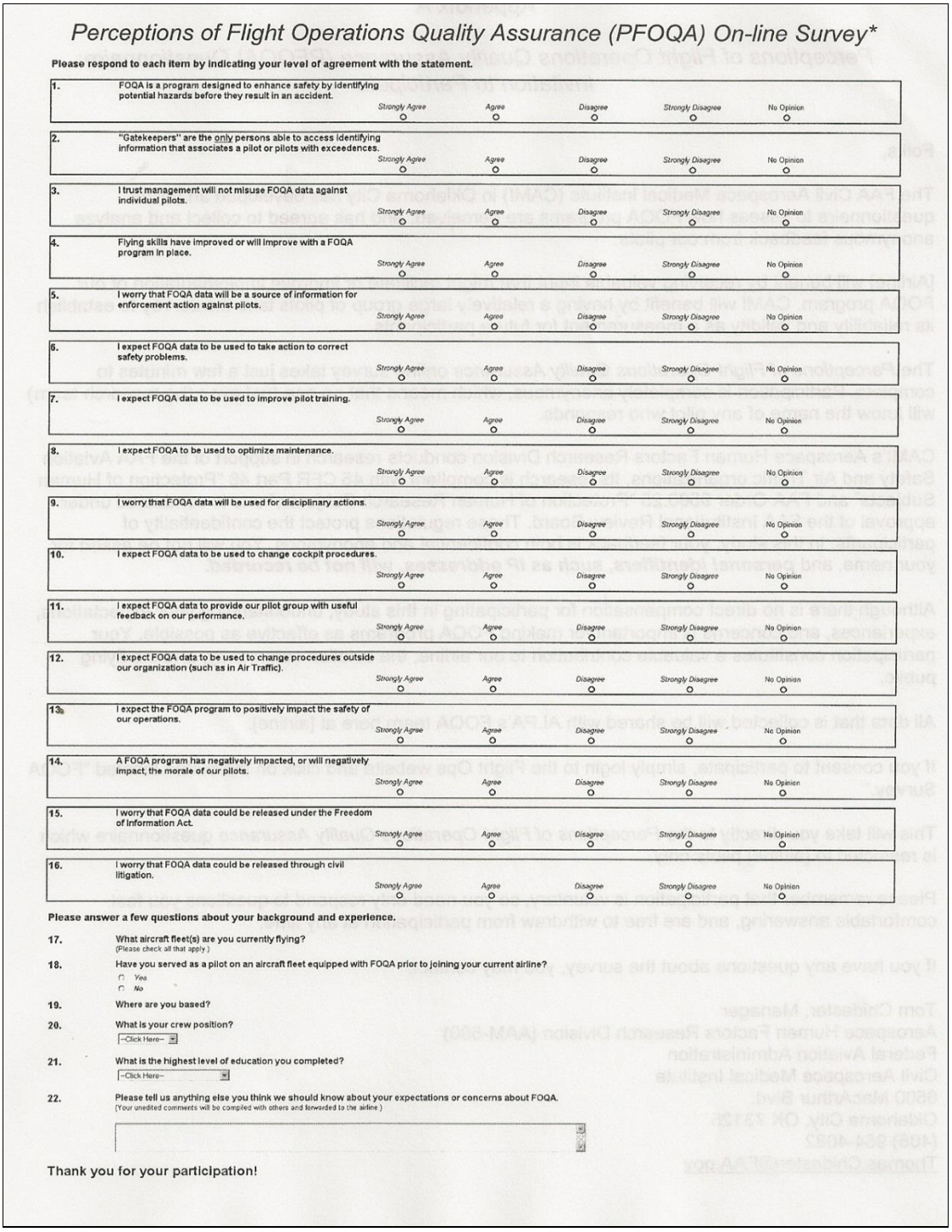
Whittingham, R. B. (2008). *Preventing corporate accidents an ethical approach*. New York: Elsevier Ltd.

Wiegmann, D.A., Hui, Z. (2011). Safety culture: An integrative review. *The International Journal of Aviation Psychology,* (14)2, 117-134.

APPENDICES

APPENDIX A

PFOQA SURVEY



*Perceptions of Flight Operations Quality Assurance (PFOQA) On-line Survey**

Please respond to each item by indicating your level of agreement with the statement.

		Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
1.	FOQA is a program designed to enhance safety by identifying potential hazards before they result in an accident.	○	○	○	○	○
2.	"Gatekeepers" are the only persons able to access identifying information that associates a pilot or pilots with exceedences.	○	○	○	○	○
3.	I trust management will not misuse FOQA data against individual pilots.	○	○	○	○	○
4.	Flying skills have improved or will improve with a FOQA program in place.	○	○	○	○	○
5.	I worry that FOQA data will be a source of information for enforcement action against pilots.	○	○	○	○	○
6.	I expect FOQA data to be used to take action to correct safety problems.	○	○	○	○	○
7.	I expect FOQA data to be used to improve pilot training.	○	○	○	○	○
8.	I expect FOQA to be used to optimize maintenance.	○	○	○	○	○
9.	I worry that FOQA data will be used for disciplinary actions.	○	○	○	○	○
10.	I expect FOQA data to be used to change cockpit procedures.	○	○	○	○	○
11.	I expect FOQA data to provide our pilot group with useful feedback on our performance.	○	○	○	○	○
12.	I expect FOQA data to be used to change procedures outside our organization (such as in Air Traffic).	○	○	○	○	○
13.	I expect the FOQA program to positively impact the safety of our operations.	○	○	○	○	○
14.	A FOQA program has negatively impacted, or will negatively impact, the morale of our pilots.	○	○	○	○	○
15.	I worry that FOQA data could be released under the Freedom of Information Act.	○	○	○	○	○
16.	I worry that FOQA data could be released through civil litigation.	○	○	○	○	○

Please answer a few questions about your background and experience.

17. What aircraft fleet(s) are you currently flying?
(Please check all that apply.)

18. Have you served as a pilot on an aircraft fleet equipped with FOQA prior to joining your current airline?
○ Yes
○ No

19. Where are you based?

20. What is your crew position?
--Click Here--

21. What is the highest level of education you completed?
--Click Here--

22. Please tell us anything else you think we should know about your expectations or concerns about FOQA.
(Your unedited comments will be compiled with others and forwarded to the airline.)

Thank you for your participation!

APPENDIX B

Oklahoma State University Institutional Review Board

Date:	Tuesday, July 05, 2011
IRB Application No	ED11124
Proposal Title:	Public Sector Pilot Perceptions of Flight Operational Quality Assurance Programs
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 7/4/2012

Principal Investigator(s):

Thomas C. Accardi
1508 Echohollow Trail
Edmond, OK 73025

Mary Kutz
6108 Winfield Dr.
Okla. City, OK 73162

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 219 Cordell North (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,

Shelia N. Kennison

Shelia Kennison, Chair
Institutional Review Board

VITA

Thomas Accardi

Candidate for the Degree of

Doctor of Education

Thesis: PUBLIC SECTOR PILOT PERCEPTIONS OF FLIGHT OPERATIONAL QUALITY ASSURANCE PROGRAMS

Major Field: Education

Biographical:

Education:

Completed the requirements for the Doctor of Education in Applied Educational Studies at Oklahoma State University, Stillwater, Oklahoma in May, 2013.

Completed the requirements for the Master of Arts in Public Administration at Long Island University, Brooklyn, New York in January 1990.

Completed the requirements for the Bachelor of Arts in Public Administration at Upper Iowa University, Fayette, Iowa in May 1976.

Experience:
Senior V.P. Aviation Management Strategy
Director, FAA Aviation System Standards
Director, FAA Flight Standards Service
Aviation Safety Inspector
FAA Academy instructor
Air Traffic controller
Commuter Airline captain
Corporate pilot
Flight Instructor

Professional Memberships:
Oklahoma State Governor's Unmanned Aerial Systems Board Member
Oklahoma State University Aviation Advisory Board
Oklahoma University Aviation Advisory Board
Meritorious FAA Executive, Presidential Rank Award
Airline Transport Pilot, Flight, Boeing 727, Beechcraft 300
Phi Kappa Phi