Summer 7-2016

The Effects of IS-BAO Implementation and Leadership Performance on Safety Culture in Business Aviation Flight Operations

Christopher Mark Broyhill
Embry-Riddle Aeronautical University

THE EFFECTS OF IS-BAO IMPLEMENTATION AND LEADERSHIP PERFORMANCE ON SAFETY CULTURE IN BUSINESS AVIATION FLIGHT OPERATIONS

by

Christopher Mark Broyhill

A Dissertation Submitted to the College of Aviation
in Partial Fulfillment of the Requirements for the Degree of
Doctor of Philosophy in Aviation

Embry-Riddle Aeronautical University
Daytona Beach, Florida
July 2016

THE EFFECTS OF IS-BAO IMPLEMENTATION AND LEADERSHIP PERFORMANCE ON SAFETY CULTURE IN BUSINESS AVIATION FLIGHT OPERATIONS

by

Christopher Mark Broyhill

This Dissertation was prepared under the direction of the candidate's Dissertation Committee Chair, Dr. Tim Brady, Professor, Daytona Beach Campus; and Dissertation Committee Members Dr. Dothang Truong, Associate Professor, Daytona Beach Campus; Dr. Antonio Cortés, Associate Professor, Daytona Beach Campus; and Dr. Terrence Kelly, External Member, and has been approved by the Dissertation Committee. It was submitted to the College of Aviation in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Aviation

Dissertation Committee:

Tim Brady, Ph.D.
Committee Chair

Dothang Truong, Ph.D.
Committee Member

Alan J. Stolzer, Ph.D.
Department Chair, Doctoral Studies

Antonio Cortés, Ph.D.
Committee Member

Tim Brady, Ph.D.
Chancellor, Daytona Beach Campus

Terrence K. Kelly, Ph.D.
Committee Member

Michael P. Hickey, Ph.D.
Dean for Research and Graduate Studies

7/12/16
Date

ABSTRACT

Researcher: Christopher Mark Broyhill

Title: THE EFFECTS OF IS-BAO IMPLEMENTATION AND LEADERSHIP PERFORMANCE ON SAFETY CULTURE IN BUSINESS AVIATION FLIGHT OPERATIONS

Institution: Embry-Riddle Aeronautical University

Degree: Doctor of Philosophy in Aviation

Year: 2016

The International Standard, Business Aircraft Operations (IS-BAO), with a Safety Management System (SMS) as its core element, has been widely accepted by both the International Civil Aviation Organization (ICAO) and the business aviation industry as the mechanism to create a healthy safety culture among the business aviation operators who have implemented the standard. Scholarly literature, however, has presented leadership as the most important factor in the creation and management of a healthy safety culture in organizations in general and aviation organizations in particular. This study examined and compared the effects of IS-BAO progression and leadership performance on the perceptions of safety culture in IS-BAO-registered business aviation organizations. Under the auspices of the International Business Aviation Council (IBAC), the 566 IS-BAO registered operations in the United States were randomly sampled, and 181 operators participated. For each selected operator, the IS-BAO registration level and the number of years the operator was IS-BAO registered were obtained through IBAC. Each of the 181 operators was provided a link to an electronic survey. The survey measured respondent perceptions of safety culture and leadership performance through the four leadership-organizational frames as theorized by Bolman

and Deal (2013): structural, human resources, political, and symbolic. A total of 980 responses were received, of which 846 were usable and 771 actually used after multivariate outliers were removed. Confirmatory factor analyses verified the safety culture perceptions construct and factor loading on Bolman and Deal's frames and demonstrated convergent and discriminant validity. Structural equation model (SEM) analysis determined the relationship between safety culture perceptions and IS-BAO progression was not significant (R = -.026, p = .933). SEM analysis was also used to examine the relationship between safety culture perceptions and leadership performance in each of Bolman and Deal's leadership frames and determined that the relationship between safety culture perceptions and leadership performance in the structural frame was positive and significant (R = .507, p = .013); the relationship between safety culture perceptions and leadership performance in the human resources frame was positive and significant (R = .505, p = .002), the relationship between safety culture perceptions and leadership performance in the political frame was not significant (R = .268, p = .405), and the relationship between safety culture perceptions and leadership performance in the symbolic frame was not significant (R = -.483, p = .095). Results of this study indicated that IS-BAO progression did not significantly affect safety culture perceptions, but leadership performance, as manifested in the structural and human resources frames, did affect safety culture perceptions. While the results were of limited generalizability due to sample size limitations, they provided scientifically derived evidence to support the importance of leadership in the creation and maintenance of positive safety culture in IS-BAO-registered business aviation operations.

DEDICATION

This work is dedicated to the men and women in the business aviation industry, an industry I have loved and served since I retired from the USAF in 2001. In the months preceding my retirement from the USAF, I was enticed to join the migration to Southwest Airlines that many of my fellow F-16 Instructor Pilots at Luke Air Force Base were making, during the period when merely knowing someone who had already been hired was nearly a guarantee of a position there. Instead, I opted for business aviation, and I have never looked back. I like the dynamic nature of the business, the personal interaction with the passengers, the camaraderie I feel with my fellow crewmembers, and the freedom to gaze at the sky from high altitude and ponder my place in the universe. But most of all, I like the way leadership works in the industry. Each flight department reminds me of a USAF fighter squadron with pilots, maintenance technicians, and scheduling personnel all focused on a single mission. At the head of that department there is a leader whose sole purpose is to accomplish the mission and take care of his or her people. If this work gives those in leadership positions some information to increase safety for their passengers and for their people, it will have succeeded beyond my wildest expectations.

ACKNOWLEDGEMENTS

Over the time frame that it has taken to compile the research behind this dissertation and write the actual document, I've changed jobs, built a five-aircraft flight department for a Fortune 500 company from scratch, written two novels, and executed three household moves. It has been a whirlwind few years.

To all those friends, acquaintances, co-workers, fellow Ph.D. students, and fellow members of the business aviation industry who encouraged me, too many to count, you have my deepest thanks. Sometimes, when I was "at the wall" during this process, your few words would keep me going.

This research would not have been possible without extensive cooperation from the International Business Aviation Council (IBAC) and especially from IBAC's Director of the International Standard, Business Aircraft Operations (IS-BAO) Sonnie Bates. Sonnie offered the services of IBAC early on, constantly asked how he could help, and completely facilitated the data-gathering process. I could not have done it without him. Thanks, Sonnie.

To the members of my dissertation committee, Drs. Brady, Truong, Cortés, and Kelly, I appreciate your patience and your direction. The dissertation process has been tedious, and I know I didn't make it easy for you, but this document would not be what it is without your guidance and participation. Thank you all.

Finally, to my loved ones, who are well acquainted to the idiosyncrasies of life with a professional writer, I am grateful for your understanding of the hours I had to spend away from you and in front of the computer or with my nose buried in books. Often your silent support was what I needed most. Thank you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Safety culture in the aviation industry has been an area of significant interest since the in-flight structural break-up of Continental Express Flight 2574 in 1991 and the National Transportation Safety Board's (NTSB) decision to make safety culture the exclusive topic at the U.S. National Summit on Transportation Safety in 1997 (Wiegmann, Zhang, von Thaden, Sharma, & Mitchell, 2002). In the NTSB's report on the Continental Express accident, the Honorable Dr. John Lauber, an NTSB board member at that time, focused on leadership's impact on safety culture and suggested that the probable cause of this accident included the "failure of Continental Express management to establish a corporate culture which encouraged and enforced adherence to approved maintenance and quality assurance procedures" (NTSB, 1992, p. 54).

Since the 1990s, there have been numerous studies and analyses performed on aviation safety culture, but few have focused on business aviation and business aviation organizations, and none has examined the impact of leadership performance on safety culture in business aviation. The dearth of studies focused on business aviation would seem to be a substantial oversight given that there are seven times the number of turbine-powered business jet aircraft than commercial passenger jet aircraft in the United States and given that U.S. turbine-powered business aircraft operators have averaged over 8,500,000 flight hours annually since 2006, while maintaining an accident/incident rate comparable with that of the major airlines (FAA, 2014; NBAA, 2014). It is the industry's focus on safety culture that has led to its safety record according to the National Business Aviation Association (NBAA), which maintains that the "business

aviation community is committed to the furtherance of a safety culture that is engrained in the people and organizations that fly business aircraft" (2014, p. 30). If NBAA's contention is accurate, then it would be useful to understand the concept of safety culture as it applies to business aviation and the effectiveness of the mechanism through which it is implemented, especially with Federal Aviation Administration (FAA) estimates that the turbine-powered business aircraft fleet will grow by an additional 20,000 aircraft and average 12,800,000 flight hours annually between now and 2034 (FAA, 2014).

In order to understand the impact of safety culture on aviation organizations in general and business aviation organizations in particular, the concept must first be defined. While definitions abound in modern scholarly and professional literature, for purposes of this research, the following definition, developed in a study commissioned by the FAA and derived from a review of the concept across several industries, is perhaps the most comprehensive:

> Safety culture is the enduring value and priority placed on worker and public safety by everyone in every group at every level of an organization. It refers to the extent to which individuals and groups will commit to personal responsibility for safety, act to preserve, enhance and communicate safety concerns, strive to actively learn, adapt and modify (both individual and organizational) behavior based on lessons learned from mistakes, and be rewarded in a manner consistent with these values. (Wiegmann et al., 2002, p. 8)

Prior to Weigmann et al.'s definition, Reason (1998) examined the cultural composition of the organization when he summarized safety culture by using some of the same elements, but Reason grouped those elements into two broad categories:

"something an organization *is* (the beliefs, attitudes and values of its members regarding the pursuit of safety), and as something that an organization *has* (the structures, practices, controls and policies designed to enhance safety)" (p. 294).

Safety culture in business aviation organizations requires the appropriate mechanism to establish and maintain it. According to the NBAA (2014), that mechanism is the International Standard, Business Aircraft Operations or IS-BAO. IS-BAO has been in existence for fifteen years, having been formally approved by the International Business Aviation Council (IBAC) in late 2001 (IBAC, 2015b). The purpose of IS-BAO is: "to promote global standardization and to assist operators in establishing quality flight operations using best practices of business aircraft and of commercial and non-commercial helicopter operations worldwide" (IBAC, 2015b, p. i). As of early 2015, there were over 700 IS-BAO registered business jet operators worldwide (IBAC, 2015a) While standardized procedures and pseudo-regulatory limitations are part of the IS-BAO, the standard centers on a safety management system (SMS) that is consistent with standards prescribed by the International Civil Aviation Organization (ICAO) (IBAC, 2015b). ICAO (2013) defines an SMS as a "systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures" (p. 10). IBAC (2015c) further describes an SMS as

> A system that facilitates the attainment (of) organizational goals in an effective and efficient manner through an integrated network of people and resources while reducing the possibility of harm to persons or property through a continuing process of hazard identification and risk management. (p. 3)

IS-BAO-registered operators progress through three levels or stages of registration as depicted in Table 1. Initial award of IS-BAO Stage 1 registration and subsequent progression to Stages 2 and 3 are functions of the status and maturity of the operator's SMS as evaluated by IS-BAO-certified auditors.

Table 1

IS-BAO Registration Stages

Stage	Timing	Criteria
1	Initial registration	Confirms that the SMS infrastructure is established and that safety management activities are appropriately targeted. All supporting standards have been established.
2	24 months after initial registration	Ensures that safety management activities are appropriately targeted and that safety risks are being effectively managed.
3	24 months after Stage 2 registration	Verifies that safety management activities are fully integrated into the operator's business and that a positive safety culture is being sustained.

Note. Adapted from "IS-BAO: An International Standard for Business Aircraft Operations," 2015, p. 1-2. Copyright by IBAC.

Statement of the Problem

Since IS-BAO Stage 3 lists the sustainment of a positive safety culture as its ultimate goal, it would seem to follow that if a business aviation organization has adopted and implemented IS-BAO and has reached Stage 3, a safety culture congruent with that defined by Wiegmann et al. should be extant. But ICAO (2013) described safety culture as a subset of organizational culture. Similarly, the FAA (2010) maintained safety culture is an aspect of an organization's overall culture. Schein (2010) argued that

organizational “culture creation and management are the essence of leadership and…leadership and culture are two sides of the same coin” (p. 3). Kotter (1996) wrote that cultural change starts with leadership. Further, the critical relationship between leadership and healthy safety culture has not only been discussed in aviation safety literature and scholarly publications, but also across a gamut of applications from energy generation to health care (Exelon Corporation, 2012; Freiwald, 2013). There seems then to be a possible contradiction as to whether leadership or IS-BAO has a greater effect on business aviation safety culture.

Purpose Statement

The purpose of this study is to examine and compare the effects of IS-BAO progression and leadership performance on the perceptions of safety culture in IS-BAO-registered business aviation organizations.

Hypotheses

Five hypotheses were necessary to examine and compare the effects of both IS-BAO progression and leadership performance on safety culture perceptions in IS-BAO-registered aviation organizations. These hypotheses were tested using structural equation modeling (SEM). Quantitative data was collected to measure safety culture perceptions, IS-BAO progression, and leadership performance. Safety culture perceptions were assessed through a survey instrument that measured the perceptions of those inside the culture. IS-BAO progression was assessed as a function of an organization’s IS-BAO stage and the years the organization had been IS-BAO registered. Leadership

performance was assessed using a construct developed by Bolman and Deal (2013). Bolman and Deal (2013) maintained that leaders interact with their organizations through four distinct contexts or frames: *the structural frame* - how the leader attunes the organization's structure to its tasks; *the human resources frame* - how the leader aligns the organization with human needs; *the political frame* - how the leader builds an agenda and power base within the organization; and *the symbolic frame* - how the leader creates meaning for the organization and those within it. The hypotheses that the SEM tested were as follows:

H_{10} – There is no significant relationship between IS-BAO progression and safety culture perceptions.

H_{1A} – The relationship between IS-BAO progression and safety culture perceptions is positive and significant.

H_{20} – There is no significant relationship between leadership performance in the structural frame and safety culture perceptions.

H_{2A} – The relationship between leadership performance in the structural frame and safety culture perceptions is positive and significant.

H_{30} – There is no significant relationship between leadership performance in the human resources frame and safety culture perceptions.

H_{3A} – The relationship between leadership performance in the human resources frame and safety culture perceptions is positive and significant.

H_{40} – There is no significant relationship between leadership performance in the political frame and safety culture perceptions.

H_{4A} – The relationship between leadership performance in the political frame and safety culture perceptions is positive and significant.

H_{50} – There is no significant relationship between leadership performance in the symbolic frame and safety culture perceptions.

H_{5A} – The relationship between leadership performance in the symbolic frame and safety culture perceptions is positive and significant.

Significance of the Study

From a general perspective, scholarly research on any aspect of the business aviation industry is somewhat rare, so the mere addition of this study to the body of knowledge in the field can perhaps expand the foundation of scholarly research on the industry for more investigation to build upon. But the specific significance of this study lies in the research areas examined, three areas in the realm of business aviation that have not been extensively studied: safety culture measurement, the evaluation of IS-BAO progression on safety culture development, and the evaluation of leadership performance on safety culture.

Safety Culture Measurement. This research utilized a survey instrument specifically designed to measure safety culture in business aviation organizations. The instrument provided measurements of safety culture constructs that parallel the safety subcultures developed by Reason (1998). Preliminary research suggests that the survey instrument used herein is one of very few in the industry that is targeted for business aviation, has been scientifically tested, and is not subject to proprietary restrictions.

IS-BAO Progression. While IS-BAO registration is not mandatory in the business aviation industry, IS-BAO registration meets the ICAO requirement for SMS implementation (IBAC, 2015). This research described the impact of IS-BAO progression on the perceptions of safety culture, and hence the effects of SMS implementation on safety culture, in business aviation operations using quantitative data, the first of its kind to do so.

Leadership Performance. The importance of leadership performance to organizational culture in general and safety culture in particular has been discussed often in scholarly, professional, and business aviation industry literature. But as yet no studies have attempted to quantify this effect on business aviation organizations. This research provided new information in this area as well.

Limitations

While random sampling was used to select operators for participation in the study, operators had the option of participating in the study or refusing to participate based on the decision of the aviation manager. After individual invitations were sent to each of the 566 U.S. IS-BAO-registered operators, only 181 operators elected to participate. Additionally, individual members of each organization selected were encouraged but not required to participate. Of 2,058 possible respondents, only 980 elected to participate, and only 846 provided usable data. Once multivariate outliers were removed, only 771 responses were analyzed. Non-response bias tests were not feasible since benchmarking data was not available for the population of IS-BAO-registered operators, and there was

no mechanism to compare the respondent variable data with non-respondent variable data. Demographic factors of pre-test and current study populations were compared and were largely equivalent, hence it would seem that the population of respondents may not have differed significantly from the population of non-respondents. Yet given the low number of responses, non-response bias may have impacted the results. Further, while the IS-BAO progression and leadership frame variables are discrete, it is possible that the two variable areas were confounded in their effects on safety culture perceptions since often it is those in leadership positions in business aviation organizations that are responsible for their organization's adoption of IS-BAO and subsequent progression therein. The impact of both non-response bias and variable confounding could limit the generalizability of the results of this study.

Delimitations

There are many factors that affect safety culture, but this study only focused on the effects of IS-BAO progression and leadership performance. Further, this study limited its discussion of leadership performance to that as measured through the four leadership-organizational frames theorized by Bolman and Deal (2013). Finally, this study only targeted IS-BAO-registered operators in the United States as its sampling frame in order to avoid language or cultural interpretation issues in the wording of questions on the survey instrument. While U.S.-registered operators comprise the overwhelming majority of world-wide IS-BAO operators, they do not constitute the entire population.

List of Acronyms

AGI	Adjusted Goodness-of-fit Index
ANOVA	Analysis of Variance
AVE	Average Variance Extracted
CASS	Commercial Aviation Safety Survey
CAPSCAS	Collegiate Aviation Program Safety Culture Assessment Survey
CFA	Confirmatory Factor Analysis
CMRS	Combined Mishap Reduction System
FAA	Federal Aviation Administration
GFI	Goodness-of-fit Index
GOF	Goodness-of-fit
IBAC	International Business Aviation Council
IS-BAO	International Standard, Business Aircraft Operations
ICAO	International Civil Aviation Organization
IRB	Institutional Review Board
MLQ	Multifactor Leadership Questionnaire
NBAA	National Business Aviation Association
NTSB	National Transportation Safety Board
SCISMS	Safety Culture Indicator Scale Measurement System
SEM	Structural Equation Modeling
SMS	Safety Management System
SPSS	Statistical Package for the Social Sciences

CHAPTER II

REVIEW OF THE RELEVANT LITERATURE

The literature supporting this study comes from several topic areas, nearly all of which pertain to the aviation industry. What follows is a review of the literature most relevant to the study on the following topics:

1) Safety culture and organizational culture;
2) Leadership;
3) Organizational culture and leadership;
4) Leadership and safety culture;
5) Safety management systems and safety culture;
6) The measurement of safety culture in previous studies; and
7) The measurement of leadership perceptions in organizations.

In addition to providing background and context for this research, the literature also revealed a gap in knowledge in the areas of business aviation safety culture measurement as well as a gap in the knowledge of the effects of IS-BAO progression and leadership performance on safety culture in business aviation organizations.

Before proceeding, a few words on the terms *leadership* and *management* are in order. From a positional perspective, there are contexts where these terms are used interchangeably and others where they are distinctly different. For the most part in the literature to follow, the terms *top management* and *senior leader* were interchangeable because the terms referred to positions within an organization and not the actions or practices of those in the positions. In those cases, *senior leader* was used in the discussion to avoid confusion. In some literature, however, the terms *leadership* and

management connote different positions, with *leadership* defining those in senior positions, and *management* defining those in middle management positions. In these latter cases, both terms were retained in the discussion.

From a practices perspective, there have been numerous differences between leadership and management that have been covered extensively in modern literature. For the purpose of this research, the difference between the two is taken from Schein (2010) where leaders are those who create and manage organizational culture while managers are those who act and maintain the status quo within that culture.

Safety Culture and Organizational Culture

The search for a standard definition of safety culture can be somewhat challenging in modern literature. In a 2004 study, Wiegmann et al. remarked that, "there exists considerable disagreement among safety professionals, both within and across industries, as to how safety culture should be defined" (p. 117). But later in the same study, the authors gleaned several commonalities in the various definitions of safety culture across several industries including aviation, nuclear and gas energy generation, off-shore energy production, road transportation, and mineral production. Those commonalities are (Wiegmann et al., 2004):

- Safety culture is a concept defined at the group level or higher that refers to the shared values among all the group or organization members;
- Safety culture is concerned with formal safety issues in an organization and closely related to, but not restricted to, the management and supervisory systems;

- Safety culture emphasizes the contribution from everyone at every level of an organization;
- The safety culture of an organization has an impact on its members' behavior at work;
- Safety culture is usually reflected in the contingency between reward systems and safety performance;
- Safety culture is reflected in an organization's willingness to develop and learn from errors, incidents, and accidents; and
- Safety culture is relatively enduring, stable, and resistant to change.

In one of the most commonly-referenced papers on the subject of safety culture, Dr. James Reason (1998) presented the importance of shared values (what is important) and beliefs (how things work) among employees that interact with an organization's structures and control systems to produce behavioral norms where safety is concerned. Reason also presented two treatments of safety culture: "as something an organization *is* (the beliefs, attitudes, and values of its members regarding the pursuit of safety), and as something that an organization *has* (the structures, practices, controls, and policies designed to enhance safety)" (1998, p. 294).

Safety culture can also be defined simply as an organizational commitment to safety at all levels of operation (McCune, Lewis, & Arendt, 2011) or as a fusion of several safety subcultures (Table 2) per Reason (1998) and Stolzer, Halford and Goglia, (2008): the informed culture, the flexible culture, the reporting culture, the learning culture, and the just culture.

Table 2

Safety Subcultures

Subcultures	Key attribute	Key behavior of members
The Informed Culture	Knowledge	Know what they need to know
The Flexible Culture	Adaptation	They can adapt when required
The Reporting Culture	Information	They tell what happened
The Learning Culture	Growth	They learn from the lessons
The Just Culture	Expectation	They know what to expect

Note. Adapted from "Safety Management Systems in Aviation" by A. J. Stolzer, C. D. Halford, and J. J. Goglia, 2008. Copyright by A. J. Stolzer, C. D. Halford, and J. J. Goglia.

ICAO (2013) has indicated that safety culture "encompasses the commonly-held perceptions and beliefs of an organization's members pertaining to the public's safety and can be a determinant of the members' behaviour" (p. 21). ICAO also depicted the link between safety culture and the culture of the organization which encompasses it, and argued that the comprehension of organizational culture is crucial to understanding safety culture (2013). The FAA (2010) made the same link, stating that the aspect of organizational culture related to safety is, in fact, safety culture itself. IBAC (2015c) maintained that in order to understand safety culture in an organization, one must first understand the organization itself.

Guldenmund (2000) studied the relationship of safety culture to organizational culture extensively and, using Schein's work on organizational culture as a framework, concluded that an understanding of an organization's basic attitudes is essential to comprehend the organization's safety culture and climate. Yin (2012) examined the relationship between safety culture and airline employees' organizational identity to

understand how airline employees implement SMS, and found that the loyalty factor of organizational identity positively and significantly predicted the performance of SMS through safety culture.

Schein (2010), one of the most cited writers on the subject of organizational culture, defined organizational culture as:

> A pattern of shared basic assumptions learned by a group as it solved its problems of external adaptation and internal integration, which has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems. (p. 18)

Schein (2010) also observed several, deep, complex, anthropological models that refer to a range of observable events and underlying forces, which provide more insight into the larger concept of organizational culture, such as:

- *Observed behavioral regularities when people interact:* the language, customs, and traditions that evolve;
- *Group norms*: the implicit standards and values that evolve in working groups;
- *Espoused values:* the articulated publicly announced principles and values that the group claims to be trying to achieve;
- *Formal philosophy:* the broad policies and ideological principles that guide a group's actions;
- *Rules of the game:* the implicit, unwritten rules for getting along in the organization;

- *Climate:* the feeling conveyed in a group by the physical layout, and the way in which members of the organization interact with each other, with customers, or with other outsiders;
- *Embedded skills:* special competencies displayed by group members in accomplishing certain tasks;
- *Habits of thinking, mental models, and/or linguistic paradigms:* shared cognitive frames that guide the perceptions, thought, and language used by the members of a group and are taught to new members in the early socialization process;
- *Shared meanings:* emergent understandings that are created by group members as they interact with each other;
- *"Root metaphors" or integrating symbols:* the ways that groups evolve to characterize themselves, which may or may not be appreciated consciously, but become embodied in material artifacts of the group; and
- *Formal rituals and celebrations*: the ways in which a group celebrates key events that reflect important values or important "passages" by members such as promotion, completion of important projects, and milestones.

If one compares Schein's list above with the list of safety culture definition commonalities from Wiegmann et al. (2004) mentioned previously, there is substantial correlation between the two that demonstrates the degree to which the elements of safety culture must be embedded in the structure of organizational culture. Wiegmann et al. (2002) presented the essence of safety culture as an organizational attribute when they provided their formal, consolidated, definition of safety culture as:

> the enduring value and priority placed on worker and public safety by everyone in every group at every level of an organization. It refers to the extent to which individuals and groups will commit to personal responsibility for safety, act to preserve, enhance and communicate safety concerns, strive to actively learn, adapt and modify (both individual and organizational) behavior based on lessons learned from mistakes, and be rewarded in a manner consistent with these values. (Wiegmann et al., 2002, p. 8)

Leadership

A search for a definition of the term *leadership* presents the opposite dilemma from that of a search for a definition of safety culture. Finding a definition of leadership is relatively simple, but choosing one is difficult. A very small sample of the existing literature illustrates the difficulty in narrowing one's scope in the search for a single definition but provides context for the direction of this study.

Helmrich (2015) provides thirty different definitions of leadership from business owners, chief executive officers, and scholars but concludes that leadership is about inspiring people to achieve goals. Economy (2015) defines leadership in terms of nine traits to include awareness, decisiveness, empathy, accountability, confidence, optimism, honesty, focus, and inspiration. Smith (1986), in his classic book on large organization leadership, "Taking Charge," defines leadership in terms of a philosophy based on 20 essential traits.

The emphasis on leadership traits has spawned entire leadership theories based on those traits which are well summarized by Phillips (2012), but go beyond the scope of

this study. Leadership has also been defined in terms of personality, the outcome of a group process, influence, and as a pattern of activities and the focus of attention and effort (Adamshick, 2007). Foisy (2008) detailed the differences in what are perhaps the two most popular modern leadership theories, those of transactional and transformational leadership, in his comparison of U.S. Air Force and U.S. Navy flying squadron commanders, and concluded there was no significant difference in the styles used by those in the different services. Transactional leaders use a contingent reward system wherein the leader solicits accomplishment of tasks by followers through promised rewards, whereas transformational leaders motivate their followers using inspiration, a sense of vision, and passion, and by exhibiting energy and enthusiasm (Foisy, 2008). General and President Dwight David Eisenhower, the leader of what was arguably the largest military force in history, summarized transformational leadership as "the art of getting someone else to do something that you want done because he wants to do it, not because your position of power can compel him to do it" (Eisenhower, 1960, p. 108).

Bolman and Deal (2013) reviewed much of the scholarly research on leadership in preparation for their own work. They summarized the major theories on leadership as:

- Leadership trait theory: how are leaders different?
- Leadership style theory: how do leaders act?
- Leadership contingency theory: how do circumstances affect leadership?
- Leader-member exchange theory: what happens in the leader-follower relationship?
- Transformational leadership theory: how do leaders transform followers? (Bolman & Deal, 2013, p. 340).

Many leadership theories focus on the leader or on the manner in which the leader interacts with subordinates, yet the theories do not directly address how the leader relates with the culture of his organization and the effect the culture has on his followers, an effect which goes well beyond those in the leader's immediate circle. Lumpé (2006) presented a comprehensive review of classical and modern leadership theories and concluded that the real difference between those theories revolves around the theories' relationship to organizational culture, specifically whether the leadership style is one where the leader's traits are independent of the organizational culture (the culture-free thesis) or whether the leader's style is bound to the organizational culture (the culture-bound thesis). Lumpé (2006) concluded that the culture-bound thesis is more directly related to how organizations work and is a more accurate reflection of how leaders lead organizations. Pater (2012) agreed, using the term *cultural changemaster* to describe the manner in which leaders are effective in organizations. Reitsema and Watkins (2012) argued that the complexity of modern organizations is such that modern leadership is less about the personnel in positions of authority and more about the organization as a system, essentially making the argument that the leader's effect on the organization's culture is vital for success.

It is the focus on leadership and organizational culture that forms the basis for Schein's theories. Schein (2010) wrote that leaders are defined through the organizational culture they create and that after the culture is formed, it is the culture itself that influences what kind of leadership is possible. He also explained that if elements of the culture become dysfunctional, leaders are the only ones capable of making the culture change (Schein, 2010).

Table 3

Bolman and Deal's Leadership Frames

Frame	Metaphor for Organization	Central Concepts	Image of Leadership	Basic Leadership Challenge
Structural	Factory or machine	Roles, goals, policies, technology, environment	Social architecture	Attune structure to task, technology, environment
Human Resources	Family	Needs, skills, relationships	Empowerment	Align organization and human needs
Political	Jungle	Power, conflict, competition, politics	Advocacy and political savvy	Develop agenda and power base
Symbolic	Carnival, temple, theater	Culture, meaning, metaphor, ritual, ceremony, stories, heroes	Inspiration	Create faith, beauty, meaning

Note. Adapted from "Reframing Organizations" by L. G. Bolman & T.E. Deal, 2013. Copyright by L. G. Bolman & T.E. Deal.

Bolman and Deal (2013) held that leadership has evolved over the last 100 years from a focus on the individual to a more complex view that focuses on the individual, the relationship, and the context. They offer five propositions to capture that evolution:

- Leadership is an activity, not a position;
- Leadership is different from management;
- Leadership is multilateral not unilateral;
- Leadership is distributed evenly rather than concentrated at the top; and

- Leadership is contextual and situated not in the leader but in the exchange between leader and constituents. (Bolman & Deal, 2013, pp. 344-346)

Bolman and Deal (2013) maintained that leaders interact with their personnel and their organization via four leadership frames as detailed in Table 3.

Table 4

Bolman and Deal's Reframed Leadership

	Leadership is effective when:		Leadership is ineffective when:	
Frame	Leadership is:	Leadership process is:	Leadership is:	Leadership process is:
Structural	Analyst, Architect	Analysis, Design	Petty bureau-crat or tyrant	Management by detail or fiat
Human Resources	Catalyst, Servant	Support, Empowerment	Weakling, pushover	Abdication
Political	Advocate, Negotiator	Advocacy, Coalition-building	Con-artist, thug	Manipulation, fraud
Symbolic	Prophet, poet	Inspiration, Meaning-making	Fanatic, charlatan	Mirage, smoke and mirrors

Note. Adapted from "Reframing Organizations" by L. G. Bolman & T.E. Deal, 2013. Copyright by L. G. Bolman & T.E. Deal.

Bolman and Deal (2013) also argued that leaders are more effective when they interact with their followers and organizations using all of the frames instead of a single or few frames. In fact, they argue that a leader may have to manifest different attributes and use different processes to be effective in the various frames, as presented in Table 4.

Several scholarly articles have been written using Bolman and Deal's frames model as a mechanism to evaluate leadership across different businesses or activities. Parry and Horton (1998) used Bolman and Deal's approach in a case study on the leadership of a Midwestern University and concluded the approach fit the historical data they considered. Scott (1999) used Bolman and Deal's construct and their instrument to measure the effect of leadership and organizational climate on intercollegiate athletic departments. He concluded the four frames were useful as descriptors of both leadership and organizational climate among the departments studied (Scott, 1999). Sasnett and Ross (2007) conducted a frame-based study of health science program directors and concluded the directors were more confident of their human resource and structural skills and less sure of the political and symbolic skills required of leaders. They further concluded the directors' mastery of the frame-based skills were correlated with their self-perceived effectiveness as managers and leaders (Sasnett & Ross, 2007). Sypawka (2008) used Bolman and Deal's frames to evaluate division deans within the North Carolina Community college system, the third largest in the nation. He concluded the deans interacted with their subordinates and organizations primarily through the human resources and structural frames which placed much less emphasis on the political and symbolic frames (Sypawka, 2008).

Phillips and Baron (2013), in a study of aviation program leaders, confirmed Bolman and Deal's conclusions in an aviation context. In their study, Phillips and Baron (2013) used a survey instrument constructed by Bolman and Deal to measure a leader's performance in the four leadership frames as well as to measure leadership/management effectiveness. Bolman and Deal's instrument seems to be one of few surveys to measure

leadership performance instead of leadership traits or transactions and has been widely used in scholarly literature as summarized by Phillips (2012).

While this review has discussed many different aspects of leadership, for the purposes of this study, the focus will be on the effect that leaders have on their organizations, an effect that will be described as *leadership performance*. It is that performance that seems to have the greatest impact on the next area to be reviewed.

Organizational Culture and Leadership

If safety culture is an element of organizational culture, as the ICAO (2013) states, the factors with the greatest influence on organizational culture should have a similar impact on safety culture. Among the factors influencing organizational culture, leadership appears to be preeminent. Schein (2010) said that organizational "culture creation and management are the essence of leadership and make you realize that leadership and culture are two sides of the same coin" (p. 3). According to Kotter (1996), culture, and the vision which accompanies it, are the responsibility of leadership. Kotter also emphasized that leading change in an organizational culture is an activity that takes considerable time and must be continually directed until the change is fully anchored in the culture, arguing the importance of leadership in that process (1996). Bass and Avolio (1993) believed that an organization's culture develops in large part from its leadership. Schein (2010) argued that as an organization succeeds in accomplishing its primary task, the leader's assumptions become part of the culture of the organization, and new members experience these cultural assumptions as a given, not as something to be discussed, i.e.: "this is the way we do things around here" (p. 232). Figure 1 illustrates

how a leader's actions and attitudes cause culture to be embedded in an organization's personnel.

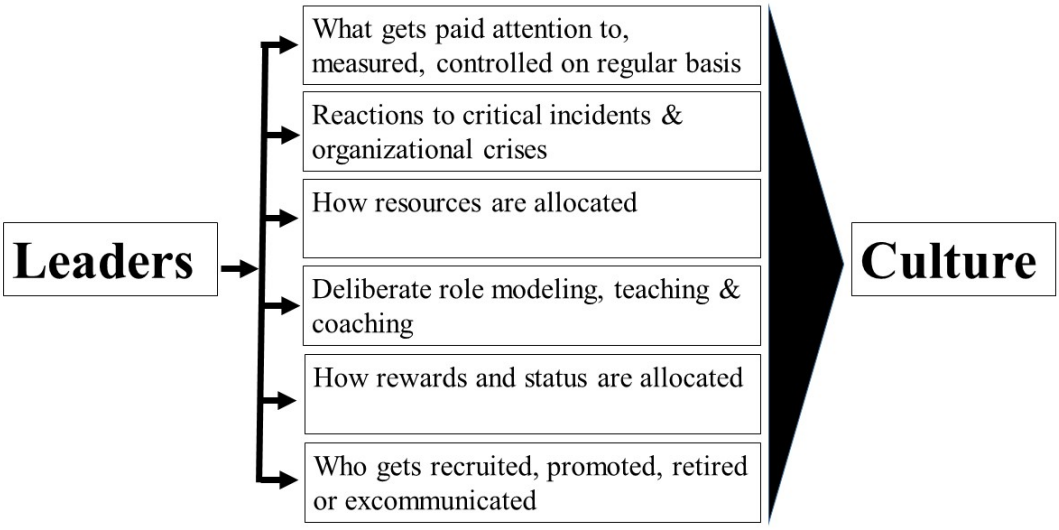


Figure 1. Leadership effect on organizational culture. Adapted from "Organizational Culture and Leadership" by E. Schein, 2010, San Francisco, CA: John Wiley & Sons. Copyright by E. Schein.

In a study using Schein's mechanisms as a template, Kelly and Earley (2009) concluded the actions of the leaders of the Arthur Andersen accounting firm led to its eventual demise. The leaders' focus on profit maximization infected the entire culture of the firm and essentially created the conditions for Andersen's role in the Enron debacle (Kelly & Earley, 2009). In a study of 32 CEOs, Giberson and his fellow researchers concluded that the personality traits of CEOs directly affected the traits and values of the organizations they led (Giberson et al., 2009). This study was the first to correlate what

many had long suspected, that the cultures of organizations are reflections of those who lead them (Giberson et al., 2009).

Leadership and Safety Culture

Thus far the literature has demonstrated that safety culture is an element of organizational culture, and leadership has a major impact on organizational culture. Now the relationship between leadership and safety culture may be examined, and there is an abundance of literature that discusses the importance of that relationship in the aviation industry.

The ICAO (2013) charged those in aviation leadership positions with the development and promulgation of the organization's safety policies, standard operating procedures, and safety resource management. ICAO also required the appointment of an accountable executive with direct responsibility for a safety program's success where its members and stockholders are concerned (2013). The FAA's safety framework echoed the ICAO requirements and specified that those in charge of aviation organizations are primarily responsible for the organization's safety management and safety culture (FAA, 2010). IBAC (2015c), in its publication "SMS Tools for Business Aircraft Operators," argues that organizational culture and leadership culture are primarily products of the leaders that create them and insists that "without leadership, safety culture is a term, a construct or a theory" (p. 8).

Flannery (2001), in a thesis describing the measurement of aviation safety culture, compared the elements / major factors of safety culture as discussed by several experts in the field. He concluded senior leadership commitment is a key element, component, or

factor in every researcher's description of safety culture and that without that commitment, a healthy safety culture does not exist.

Wiegmann et al. (2004) maintained that an aviation organization's commitment to safety refers to the extent to which those in leadership positions identify safety as a core value of the organization and guide the organization to demonstrate an enduring, positive attitude toward safety, even in times of fiscal austerity. When senior leaders are committed, they actively promote safety in a consistent manner across all levels within the organization. Senior leadership also provides adequate resources and consistently supports the development and implementation of safety activities as well as ensuring every aspect of operations, such as equipment, procedures, selection, training, and work schedules are routinely evaluated and, if necessary, modified to improve.

Stolzer et al. (2008) argued positive safety culture in aviation organizations is generated from the top down and that those in senior leadership positions must set the stage through their actions. Senior leaders must also demonstrate commitment to safety in all decisions they make, including directing the resources of the organization to address safety concerns. Further, senior leadership must establish safety as a core value of the organization and acknowledge that the nature of the organization's activities is high-risk and high-consequence. Finally, trust must permeate the organization, and all members of the organization must believe that they will be supported by the organization when they make decisions in the interest of safety.

In an article encapsulating some 30 years of research on safety climate, a concept that follows naturally from safety culture according to Guldenmund (2000), Zohar

(2010), observed that the consensus of most writers on the subject has been that leaders create climate and that leadership is a climate antecedent. Further he observed:

> The relationship between leadership and safety climate has been largely explained as an extension of the leader's concern for group members' welfare. Effective leaders who have established high quality relationships with their unit members care about their psychological welfare. Such caring extends to physical welfare in situations involving heightened risk. (Zohar, 2010, p. 1519)

Torres (2011) said in "the Coast Guard, as in other military services, the term command climate is often substituted for safety culture" (p. 111). To support his statement, he provided a list of tasks that field commanders must be able to perform, derived from a review of military literature:

- Articulate a clear vision and establish attainable goals;
- Allow subordinates freedom to exercise initiative;
- Establish accountability at appropriate level;
- Show confidence in subordinates;
- Encourage and reward prudent risk-taking;
- Achieve high performance through positive motivation and rewards;
- Give clear missions within boundaries of autonomy;
- Listen to subordinates and seek ideas;
- Demonstrate concern about the welfare of subordinates; and
- Establish and model high ethical standards. (Torres, 2011, pp. 111-112)

Torres (2011) also insisted that if safety culture and command climate are interchangeable, then a major indicator of a positive command climate (or safety culture)

is the credibility of the commander. When that credibility is high, there will be increased reporting, trust, and confidence in the overall system and clear communications up and down the chain of command in the organization.

McCune et al. (2011) wrote that in a healthy aviation safety culture, those in leadership positions place strong emphasis on safety by manifesting the same behaviors previously discussed. These behaviors include:

- Understanding of hazards within the workplace,
- Accepting criticism;
- Remaining open to opposing views;
- Fostering a climate that encourages feedback;
- Emphasizing the importance of communicating relevant safety information;
- Promoting realistic and workable safety rules; and
- Ensuring staff are well educated and trained so that the consequences of unsafe acts are understood. (McCune et al., 2011)

Wolf (2012), in a comprehensive review of the need for SMS implementation throughout the aviation industry, argued that safety begins from the top in organizations, and called for the executives of aerospace organizations to lead the way by developing a safety culture that permeates each organization. He also discussed the importance of the safety advisor in that process to ensure the executives have the latest information and data to reinforce the safety culture.

Freiwald (2013) investigated the relationship among ethical leadership, an ethical workplace climate, safety culture, safety behaviors, and measured safety outcomes of workers in the high reliability organizations of aviation and healthcare. His research

revealed that perceptions of an ethical workplace climate can yield significant impact upon an organization's safety culture, while workplace perceptions of ethical leadership are directly related to safety outcomes.

Finally, Cooper (2015) wrote that a company's safety culture is driven by an executive leadership team that "creates, cultivates and sustains a company's journey to excellence" (p. 49). Cooper believed it was the executives' responsibility to set the vision and strategic direction, provide resources, and constantly emphasize and reinforce the importance of safety to people and the business.

Safety Management Systems and Safety Culture

Scholarly literature that discusses IS-BAO and safety culture is somewhat rare. But since the SMS is the core element of IS-BAO, a review of the relevant literature that discusses SMS and safety culture should provide a similar context to the possible impact of IS-BAO on safety culture.

In one of the earliest articles written about SMS by a member of the FAA, Smith (2005) wrote that to be successful, an SMS must be an integrated collection of policy, architecture, assurance, and safety promotion. Smith argued that safety culture was part of the safety promotion element of the SMS but also contended that the SMS had to be implemented with a safety culture in place, or it would not be successful.

ICAO (2013) discussed the importance of safety culture and organizational culture in the establishment and operation of an effective SMS but did not seem to contend whether safety culture facilitates SMS implementation or is a product of that implementation. In contrast, the FAA (2010), similar to Smith (2005), stated the

structural elements to create a safety culture, including safety policies, are the items which are most under management control and hence should be implemented first in order to facilitate an effective SMS. IBAC (2015c) argued that safety culture provides the environment or the atmosphere in which the SMS functions. Further, IBAC (2015c) insisted that "safety culture is to SMS what air is to living creatures. If the atmosphere is healthy, the SMS thrives. If the atmosphere is poisonous or non-existent, the SMS becomes inanimate" (IBAC, 2015c, p. 7).

Grote (2012), in a review of safety management processes across several high-risk activities, condensed the implementation of safety management into two separate definitions. One definition focused on arrangements made by the organization for the management of safety in order to promote a strong safety culture and achieve good safety performance. Essentially, this definition focused on safety culture as the primary goal or product of safety management with the aim of achieving good safety performance. The other definition emphasized an organized approach to managing safety, including the necessary organizational structures, accountabilities, policies, and procedures. In this definition, safety culture isn't mentioned specifically, and safety management is seen as more process driven, similar to other management systems such as qualify management. Grote (2012) does emphasize, however, that in most of the literature he reviewed, the concept of safety culture is frequently evoked as both a prerequisite for and the effect of good safety management.

Remawi, Bates, and Dix (2011) administered a safety culture survey to workers at a large international airport to measure the change in worker safety attitudes a year after an SMS had been introduced there. Using another large airport with an SMS in operation

as a control group, the average score on the survey reported by survey respondents at the airport with the new SMS increased significantly in the areas of safety communications, safety rules, supportive safety environment, personal risk appreciation, work environment, and involvement while the same scores from the airport that had an SMS in place stayed constant. The authors concluded that the implementation of an SMS did increase positive perceptions of safety culture.

Lin (2012) conducted a study of airline pilots in Taiwan to determine the relationship of organizational identity, a function of organizational culture, to safety culture and SMS implementation. He concluded that safety culture was strengthened as the result of the implementation of an SMS and that the loyalty factor of organizational identity positively and significantly predicted the performance of SMS through safety culture. While his results indicated that SMS strengthened safety culture, Lin's study used SEM and path analysis to show that SMS performance was affected by the employee's loyalty to the organization and the employee's identification with the organization. According to Schein (2010), loyalty and identification are attributes of organizational culture and are largely leadership driven. The impact on loyalty and identity in Lin's study begs the question of whether the improvement in those areas was due to SMS implementation or the overall culture surrounding that implementation.

In the only study found that focused on business aviation, McNeely (2012) researched the correlation between SMS implementation and organizational safety culture with a survey of four 14 C.F.R. Part 135 on demand charter air carrier operators. He concluded that the correlation between the level of SMS implementation and the level of organizational safety culture was positive and significant. McNeely also concluded

that the level of management involvement correlated positively and significantly with the level of safety culture, but his study assumed that safety culture was a product of SMS implementation and not a precursor for that implementation. Interestingly, while McNeely addressed the theory that safety culture must exist for SMS implementation to be effective, his study methodology did not seem to take that possibility into account.

Freiwald, Lenz-Anderson, and Baker (2013) studied the safety culture and attitudes of a multi-campus, multi-national flight training organization that had experienced multiple hull losses and had no formal safety management system in place. Using a mixed methods approach incorporating survey research, they concluded that an effective safety culture did not exist in the organization. They recommended the implementation of a safety management system to create a better safety culture in the organization.

Adjekum (2014) studied safety culture perceptions as a function of SMS implementation in a four-year collegiate aviation program. Using a survey instrument based on the Commercial Aviation Safety Survey (CASS), he determined that perceptions of safety culture improved the longer personnel remained with the program and varied depending on the nationality of the respondent. While he discussed the importance of safety culture to successful SMS implementation, he did not examine the effect of SMS implementation on safety culture or vice-versa.

Woo (2015), in a case study of a small flight school organization, wrote that developing and maintaining a strong safety culture is a critical prerequisite for implementation of an SMS. He maintained that an SMS did not create a safety culture, but that the safety culture provided the environment for the SMS to be effective.

Overall, there is some disagreement as to whether safety culture is a precursor to or a product of safety management system implementation in the literature reviewed. But that same literature is consistent in depicting a positive relationship between safety culture and SMS implementation, a relationship this study will further explore in the context of IS-BAO implementation.

Measurement of Aviation Safety Culture in Previous Studies

Now that the literature involved with organizational culture, leadership, safety culture, and safety management systems has been discussed, an examination of the measurement of safety culture itself is in order. While this review is not exhaustive, it provides an overview of the manner in which aviation safety culture has been measured and reveals that business aviation safety culture measurement has largely been ignored. Some of the studies reviewed in the preceding section are discussed again in this section; however, the focus here is on the measurement and analysis mechanisms utilized by the researchers rather than the conclusions presented.

Flannery (2001) discussed the measurement of safety culture in aviation, but only spoke to the topic in theoretical terms. He derived definitions of safety and safety culture and then presented possible measurement systems, finally concluding, at that time, an adequate measurement tool for that measurement did not exist (Flannery, 2001).

Gibbons, von Thaden, and Wiegmann (2006) attempted to validate a safety culture survey for aviation operations based on a five-factor model that included organizational commitment, management involvement, pilot empowerment, reporting systems, and accountability systems as they pertained to safety within an airline. The

survey, then designated as the Commercial Aviation Safety Survey (CASS), was designed around these five factors, and was distributed to pilots and managers of a large U.S. airline for anonymous completion (Gibbons, von Thaden, & Wiegmann, 2006). Results of the authors' series of confirmatory factor analyses indicated that the original five-factor model of safety culture did not fit as well as hypothesized (Gibbons et al., 2006). The model was revised to focus on four main factors; organizational commitment, operations interactions, formal safety system, and informal safety system.

Díaz-Cabrera, Hernández-Fernaud, and Isla- Díaz (2007) evaluated a safety culture measurement instrument that centered on the organizational values and practices related to the safety management system. They explored seven dimensions that reflected underlying safety meanings and the four cultural orientations in the field of safety arising from the competing values framework (Díaz-Cabrera et al., 2007). The authors then surveyed 299 participants from five companies in different industrial sectors, only of one which was aviation-related. While they admitted that their results were inconclusive, they noted that organizations in different industrial sectors seemed to emphasize different safety-related organizational values and hence, the safety cultures in each sector varied from its counterparts in other sectors.

Guldenmund (2007) said that questionnaires were not particularly successful in measuring organizational safety culture. He believed they focused too much on evaluations of those in charge and not on the basic cultural assumptions at different levels of the organization (Guldenmund, 2007). Guldenmund seemed to disregard the impact of leadership on that culture in his 2007 study, a curious outcome given that his earlier research involved multiple references to Schein's work (Guldenmund, 2000).

Von Thaden, Kessell, and Ruengvisesh (2008) built upon von Thaden's earlier work by administering the revised four-factor CASS to the flight operations department of a large, major European airline. Their analysis confirmed the existence of a positive, effective safety culture within the organization (von Thaden, Kessel, & Ruengvisesh, 2008).

Later in 2008, von Thaden and Gibbons released an FAA-funded report describing the measurement construct of their revised instrument, now named the Safety Culture Scale Measurement System (SCISMS) (von Thaden & Gibbons, 2008). The authors said their instrument fused techniques to measure both organizational safety culture and professional safety climate in aviation organizations and provided a tool to measure the evolution of organizational safety culture in large commercial airlines.

In 2010, Kelly, Meyer, and Patankar used SEM to verify a pyramid construct of safety culture first proposed by Patankar and Sabin in 2008. The pyramid consisted of four distinct yet interdependent layers, to wit:

> The base of the pyramid included safety values and unquestioned assumptions that serve as the foundation of the model. The second layer is described as safety strategies and consists of leadership strategies, policies, procedures, organizational norms, history, legends and heroes. The third level of the pyramid represented the safety climate of the organization and consists of the short and near-term set of attitudes and opinions surrounding safety. The apex of the Pyramid represented safety behaviors and consists of individual and group safety-related behaviors within the organization. (Kelly, Meyer, & Patankar. M., 2012, p. 4)

Using data from an existing dataset from a major international carrier and questions selected from four different survey instruments, Kelly et al. demonstrated that a four-factor model based on the pyramid construct fit the data somewhat better than a single-factor model through confirmatory factor analysis (CFA) (2012). They then analyzed different groups of respondents to determine if the factor loadings on the CFA were higher for some groups of respondents than others, such as managers, production supervisors and engineers (Kelly et al., 2012). Although the model fit all three groups well, it seemed to fit the managers and production supervisors better than the engineers. Apparently, no pilots were surveyed.

To assess safety culture in their study of workers at two international airports, Remawi, Bates, and Dix (2011) used a survey instrument constructed by the authors' research supervisors, largely based on the U.K. Workplace Health and Safety Culture Survey. The survey used a 5-point Likert-type scale, ranging from 1 (strongly agree) to 5 (strongly disagree). Demographic questions were included to identify participant characteristics. The survey was presented twice to personnel at the airports with a year's time between each presentation. An analysis of variance (ANOVA) was performed on the data generated by the instrument to determine if the mean scores of the safety culture variables were significantly different for personnel at each airport after a year had passed. At the airport where the SMS had been in place all along, the control airport, the mean scores of the safety culture survey variables were not significantly different between the two survey presentations. At the airport where the SMS had been newly implemented, the mean scores of the safety culture survey variables were significantly different

between the two presentations and indicated personnel felt the safety culture had improved.

Lin (2012) built a unique survey instrument for his study of airline pilots in Taiwan that focused on the relationship of organizational identity (essentially organizational culture) to safety culture and SMS implementation. Based on interviews with safety managers and content analyses of the airlines safety manuals and safety audit reports, he constructed a 37-question survey using a 5-point Likert scale to assess the respondent's attitude toward the airline's safety culture and safety management system. Lin analyzed the data generated by his survey with SEM and path analysis and concluded that organizational identity positively impacted safety culture and SMS implementation.

In his research on the correlation between SMS implementation and safety culture, McNeely (2012) adapted a survey from Gibbons, von Thaden, and Wiegmann's CASS. His instrument was developed via field tests using the input of subject matter experts and featured a 5-point Likert scale for respondents to rate their perceptions of safety culture and safety management system effectiveness. He concluded that the correlation between the level of SMS implementation and the level of organizational safety culture was positive and significant. Further, he noted that the relationship between management commitment (leadership) and safety culture was positive and significant as was the relationship between safety promotion (a function of leadership-directed safety policy) and safety culture. While McNeely's research provides context for the present study, it focused on a small number of air carrier operators and did not include private corporate operators. The small number of operators surveyed, four, correspondingly limited the number of organizational cultures examined and hence did

not determine the effect of SMS implementation across a wide cross section of operations.

Freiwald, Lenz-Anderson, and Baker (2013) used Gibbons, von Thaden, and Wiegmann's CASS, with a 5-point Likert scale, to collect quantitative data in their assessment of the safety culture of a multi-national, multi-campus flight training organization. They used factor analysis to validate the constructs of the 83-item instrument, organizational commitment, management involvement, pilot empowerment, reporting systems, and accountability systems, but this portion of their analysis of the factor loading was somewhat inconclusive because they only received 63 responses with which to analyze the 83 variables. However, their multivariate analysis of variance produced useable results that showed positive and significant relationships between attitudes toward the various safety culture elements in the CASS and respondent characteristics such as respondent location, gender, and position within the company.

Adjekum (2014) studied safety culture perceptions as a function of SMS implantation at a four-year collegiate aviation program. Like previous researchers, Adjekum used a modified and re-validated version of the CASS that he called the Collegiate Aviation Program Safety Culture Assessment Survey (CAPSCAS). The CAPSCAS featured 62 items, each with a 5-point Likert scale and assessed respondent attitudes on the areas of their organization's formal safety program, informal safety program, operations interaction, and organizational commitment. Interestingly, while Adjekum discussed the safety subcultures developed by Reason (1998), he did not attempt to modify the CASS in a manner to assess those subcultures, but instead used the original subareas developed by von Thaden, Wiegmann, and Gibbons. Adjekum received

142 usable responses from the 944-member sampling frame he developed, and conducted an ANOVA to determine if there were significant differences in respondent attitudes toward safety culture as a function of the respondent's time in the program and whether the respondent was a U.S. or international student. He concluded the longer a respondent spent in the program, the better the respondent's perceptions of the safety culture, and U.S. students had more favorable perceptions of the safety culture than did international students.

The USAF also uses survey tools to assess safety culture. The service's Combined Mishap Reduction System (CMRS) features ten safety culture surveys for elements of operational units such as operations and maintenance (USAF, 2012). The surveys provide quantitative data using a 5-point Likert scale and also solicit demographic information on the respondent (USAF, 2012).

In summary, modified versions of von Thaden, Wiegmann, and Gibbons' CASS, a tool developed to assess safety culture in large commercial operations, seems to be common when assessing aviation safety culture in aviation organizations that are not commercial in nature, including the one study of a business aviation organization reviewed here. A modified version of the CASS is used to assess safety culture in this study and will be discussed in depth in the next chapter.

Measurement of Leadership Performance in Aviation Organizations

There have been many studies that have measured the effect of leadership and styles of leadership on organizations, yet surprisingly few have dealt with aviation organizations.

Lumpe (2006), in his study of leadership and organization in the aviation industry, used an instrument he adapted from the organizational culture assessment tool developed by Global Leadership and Organizational Behavior Effectiveness Research Program. His instrument was designed to measure respondents' opinions of overall organizational culture from within 12 different professional cultures or clusters he identified within the aviation industry from line technicians to flight crew to information technology professionals to middle and strategic management. While Lumpe's focus was applicable to the present study, the tool he used focused more on the culture itself and not leadership's impact or performance on that culture.

Foisy (2008) measured differing levels of transactional, transformational, and passive-avoidant leadership behaviors between USAF and U.S. Navy flying squadron commanders and determined there were not significant differences between the two groups. The instrument he used, the Multifactor Leadership Questionnaire (MLQ), uses 45 questions to assess the leadership behaviors using a 5-point rating scale. While the MLQ is widely recognized as a validated instrument to measure leadership behaviors, the behaviors it measures, transactional and transformational leadership, focus more on the leader's behavior in relationship to the subordinate and less on the leader's behavior as it relates to the culture of the organization. In his research, Foisy (2008) focused on leadership behaviors themselves and not leadership performance for the organization.

Krear-Klostermeier (2012) also used the MLQ to measure the leadership styles of FAA air traffic control managers. She found that the transformational style of leadership prevailed in her research, but she, like Foisy (2008), focused on leadership style not necessarily leadership performance (Krear-Klostermeier, 2012).

Freiwald (2013) studied the effect of ethical leadership on safety outcomes in high-reliability organizations in both the aviation and health care fields. The data collection device he used featured 31 questions that measured leadership integrity but did not assess leadership performance.

Using Bolman and Deal's Leadership Frame Questionnaire, Phillips and Baron (2013) measured the effectiveness of the leaders of collegiate aviation programs as a function of the organizational frame in which the leader operated. The authors chose Bolman and Deal's instrument because they believed Bolman and Deal's leadership construct, along with its associated instrument, was the most appropriate tool to accurately measure the impact of collegiate aviation program leaders on their associated organizations.

Even with the few studies on aviation leadership performance located and discussed, a reasonable cross-section of measurement instruments have been utilized. Instruments have focused on various elements such as organizational culture, leadership traits, the ethics of leadership, and the impact of leaders on their organizations. Hence it would seem that the choice of the applicable instrument is a function of the goal of the research or researcher.

Summary

The literature presented has manifested a few items of consensus that seem clear:

1) Safety culture is an element of organizational culture and can be, to a degree, defined;

2) Rather than traits or actions, leadership performance, a measure of a leader's effect on his or her organization, is the most applicable construct to assess for the purpose of this study;
3) Leadership performance can be defined in the context of organizational culture and, correspondingly, organizational culture is largely a function of leadership performance;
4) Safety culture, as an element of organizational culture, is also largely a function of leadership performance;
5) SMS has had a favorable impact on safety culture in aviation;
6) Most of the safety culture measurement that has taken place in the aviation industry has focused on commercial aviation. Yet even the studies that have not concentrated on commercial aviation have used adaptations of the CASS for safety culture measurement. It would seem then, that adaptions of the CASS for safety culture measurement outside of commercial aviation have been accepted as valid by scholarly writers;
7) Most leadership measurement instruments for studies involving aviation organizations have not focused on leadership performance. Bolman and Deal's Leadership Frames Questionnaire is a notable exception and will be discussed in the next chapter;
8) Apart from McNeely (2012), there have been no other studies found that have addressed safety culture or safety culture measurement in business aviation; and

9) There have been no scholarly studies of the effects of IS-BAO implementation or leadership performance on safety culture in business aviation organizations. This gap in knowledge will be addressed by this study.

CHAPTER III

METHODOLOGY

In order to examine and compare the effects of IS-BAO progression and leadership performance on business aviation safety culture, this study focused on U.S. IS-BAO-registered operators and used a data collection instrument that measured both the safety culture perceptions and leadership performance as assessed by the members of those operations. Data generated by the instrument was evaluated using descriptive statistics, confirmatory factor analysis (CFA) and structured equation modeling (SEM). This research was conducted with the approval and cooperation of IBAC (Appendix H) as well as the approval of the Institutional Review Board (IRB) at Embry-Riddle Aeronautical University (Appendix G).

Research Approach

The variable constructs referenced in this research appear in Table 5. Quantitative data was collected via survey instrument and analyzed. Analysis was comprised of a first order CFA on the safety culture constructs, a first order CFA on the leadership performance constructs, a second order CFA to test discriminant validity between the two constructs, and a SEM to test the hypotheses. Standardized regression weights generated by the SEM were examined to determine if the hypothesized relationships were positive and significant. Regression weights were also compared to determine which relationships might be stronger than others. A simplified version of the SEM appears in Figure 2. The full SEM appears in Appendix F.

Table 5

Variable Constructs

Construct Name	Construct Label	Construct Inputs
Safety Culture Perceptions	SCP	Survey Variables SCP_1 - SCP_23
IS-BAO Progression	IP	IS_Stage & IS_Years
Leadership Performance in the Structural Frame	LP_SF	Survey Variables SF_1 - SF_8
Leadership Performance in the Human Resources Frame	LP_HRF	Survey Variables HRF_1 - HRF_8
Leadership Performance in the Political Frame	LP_PF	Survey Variables PF_1 - PF_8
Leadership Performance in the Symbolic Frame	LP_SYF	Survey Variables SYF_1 - SYF_8

Population/Sample

To adequately target the population of U.S. IS-BAO-registered operators, random cluster sampling with replacement was the initial sampling methodology envisioned. Vogt, Gardner, and Haeffele (2012) recommended the use of cluster sampling when a frame of individual respondents is not readily available. In order to limit language and national cultural interpretation issues, the sampling frame was confined to the population of 566 IS-BAO registered operators (the clusters) based in the United States at the time of the study, as supplied by IBAC's Director of IS-BAO, Sonnie Bates (personal communication, June 22, 2015). Krejcie and Morgan (1970) indicated that given a population of 566 members to study or survey, a sample size of 229 is sufficient; hence 229 operators were to be selected from the population for this study. The roster of U.S.-based IS-BAO registered operators was numbered sequentially and then randomly

ordered. Initially, the process was to involve email invitations to the aviation managers of each of the first randomly-selected 229 operations to ask the manager if his or her organization would participate. For each aviation manager that declined, another would be selected further down the roster. In actuality, due to the lack of response, individual invitations with embedded survey links were sent to each of the 566 aviation managers on the roster, with the goal of only using the first 229 organizations on the randomly-ordered list that chose to participate. This methodology may have affected the randomness of the sampling method and, in fact, generated a sample of convenience. Only 181 operators elected to participate and of those, 69 operators had only one survey respondent. Of the 2,058 possible participants among the 181 operators, 980 chose to participate for a response rate of 47.62%.

Westland (2010) analyzed studies and approaches for the determination of the minimum sample size necessary to adequately evaluate a SEM and derived a formula for minimum sample size. Soper (2015) implemented that formula in an online calculator to ascertain that minimum sample size. Using a desired effect size of .1, the smallest effect / correlation level discussed by Westland (2010), a statistical power level specified by convention of .8 (Soper, 2015), and the 57 observed and 10 latent variables in the SEM (Figure 2), the calculator generated a minimum sample size of 703 cases to detect effect, a minimum sample size of 160 cases to validate the model's structure, and a recommended sample size of 703 cases. This criteria was achieved by the data collected and analyzed.

Data Collection Device

The data collection instrument used in this research (Appendix A) is composed of two surveys, one that measures safety culture perceptions and another which measures leadership performance. The instrument was administered through the Survey Monkey website at www.surveymonkey.com.

Safety culture instrument description. In order to develop a tool to assess safety culture in business aviation operations, an instrument was devised that features questions adapted from a published version of the CASS (Gibbons & von Thaden, 2006), a question derived from Dr. James Reason's safety culture survey (Transport Canada, 2008), and questions derived from Stolzer et al. (2008). An annotated version of the first pre-test instrument with question-by-question citations appears in Appendix B. The instrument included several features that were used to optimize it for business aviation operators:

- It contained questions designed to measure the five safety subcultures listed by Reason (1998) and Stolzer et al. (2008): the informed culture, the flexible culture, the reporting culture, the learning culture, and the just culture;
- Questions were included to assess leadership performance in the context of safety culture;
- Question phraseology was modified to use terms familiar to business aviation personnel; and
- Survey length was limited to allow for swift completion since participation would be voluntary.

The instrument was pre-tested twice using IBM's Statistical Package for the Social Sciences (SPSS) AMOS software to assess its content and construct validity as well as its reliability (Broyhill, 2014). The first pre-test used data collected from 13 IS-BAO registered operators with 101 respondents. An exploratory factor analysis revealed eight factor areas instead of six, although some of the factor areas generated could not be assessed adequately due to sample size limitations. The exploratory factor analysis also showed that the variables that assessed leadership performance did not factor into one discrete area but were spread across several other measurement areas. The instrument demonstrated content validity as assessed by the respondents and also demonstrated scale reliability in all but one measurement area, the flexible culture (Broyhill, 2014).

The second pre-test collected data from 18 IS-BAO registered operators with 232 respondents (Broyhill, 2014). A revised instrument was used (Appendix C), featuring the five areas specified by Reason (1998) and Stolzer et al. (2008) and a leadership area. A seventh area, the empowered culture, which reflects employees' ability to change the organization and is closely aligned with the concept of empowered accountability as described by Cortés and Rogers (2013), was added as a result of the findings of the first pre-test. Sample size in the second study was adequate, and after a confirmatory factor analysis and accompanying post hoc analyses were conducted, the revised instrument revealed high content validity and construct validity. The instrument also demonstrated adequate scale reliability overall in all but one subarea, the flexible culture (Broyhill, 2014).

For the instrument used in the current study (Appendix A), survey questions 6-9 on the second pre-test instrument (Appendix C), which measured "The Flexible Culture"

per Reason (1998) and Stolzer et al. (2008) were removed due to low scale reliability. Survey questions 28-30 on the second pre-test instrument (Appendix C), which measured "The Leadership Culture" were removed to prevent cross-loading on the leadership performance constructs. The rating scale for respondents was changed from a 7-point Likert scale in the original instrument to a 5-point Likert scale to match the rating scale on the leadership performance measurement instrument.

Safety culture instrument reliability. The scale reliability statistics for the pre-test of the applicable measurement areas of the safety culture assessment instrument appear in Table 6. The standardized Cronbach's alpha values show adequate scale reliability in all areas. Scale reliability was assessed again in the current study using the same criteria.

Table 6

Pre-Test Safety Culture Measurement Instrument Reliability

Measurement Area	Questions	α – unstandardized	α – standardized
The Informed Culture	5	.714	.730
The Empowered Culture	4	.716	.718
The Reporting Culture	5	.758	.763
The Learning Culture	4	.680	.704
The Just Culture	5	.811	.822

Note. These reliability statistics were not published in the cited AeroSafety World article (Broyhill, 2014) but were produced in the research that generated the article

Safety culture instrument validity. While construct and content validity for the instrument were confirmed in the pre-tests, since a revised instrument was used in the

current study, additional tests for validity were required. A first order confirmatory factor analysis was conducted in the current study to confirm the construct validity of the instrument. Model fit, convergent, and discriminant validity were assessed as part of the analysis, the methodology and criteria of which is discussed later in the study.

Leadership instrument description. The decision process for a leadership performance measurement instrument considered two criteria. First, the instrument had to actually measure leadership performance, not leadership traits. Second, the instrument had to be relatively brief in order to ensure maximum voluntary participation by respondents.

Denison (2015) offered the use of the Denison Survey, an instrument that measures organizational culture as affected by leadership performance. Conversations with Mr. Ken Uehara at Denison revealed that respondents would not only have to complete the organizational culture survey but also complete a 360-degree survey on those in leadership positions, and the results from the two surveys would have to be correlated to measure leadership performance (personal communication, April 21, 2015). Although the Denison instrument has been validated through scholarly study (Denison, Nieminen, & Kotrba, 2014), the required survey process seemed too lengthy to ensure maximum participation by respondents.

The Leadership Circle also offered the use of the Leadership Culture Survey which measures leadership performance across two domains, creative competencies and reactive tendencies (TLC, 2015). The instrument featured 62 questions / variables and required the respondent to answer each item twice, once in the context of the way the

respondent feels the organizational leaders currently act and once in the way the respondent feels organizational leaders would act in the respondent's conception of an ideal organization (TLC, 2015). Further discussion with Mr. Michael O'Connor of The Leadership Circle revealed that the comparison between the scores generated by respondents' ideas of the present organization versus those of the respondents' ideas of the ideal organization provided the measure of leadership performance (personal communication, April 22, 2015). While this survey offered scientifically valid and reliable data, the length of the questionnaire, some 124 items, seemed excessive for potential respondents in business aviation organizations. Also, the alignment of the survey constructs did not parallel Schein's conception of leadership performance in the context of organizational culture.

Bolman and Deal's Leadership Frames Questionnaire was the instrument that seemed most suitable both to the measurement of leadership performance (included in Instrument at Appendix A and in original form in Appendix D). Also, since the instrument contained only 32 total questions, it seemed to be brief enough to ensure maximum participation. Bolman and Deal's survey is designed to specifically measure leadership performance across the four leadership frames theorized by the designers. Interestingly, while Bolman and Deal (2013) and Phillips (2012) maintain that symbolic frame is where the classic elements of organizational culture are found, the behavior that leaders use to embed culture in their subordinates and organizations per Schein (2010), seen in Figure 1, align well with the structural, human resources, and symbolic frames, as depicted in Table 7. Bolman's permission to use the instrument for this study appears in Appendix E.

Table 7

Comparison of Leadership Culture Behaviors and Leadership Frames

Leadership Culture Embedding Behavior Schein (2010)	Corresponding Leadership Frame Bolman & Deal (2013)
What gets paid attention to, measured, and controlled on regular basis	Structural
Reactions to critical incidents and organizational crises	Structural
How resources are allocated	Political
Deliberate role modeling, teaching and coaching	Human Resources
How rewards and status are allocated	Political
Who gets recruited, promoted, retired, or excommunicated	Human Resources

Note. Adapted from "Organizational Culture and Leadership," by E. Schein, 2010. Copyright by E. Schein. Also adapted from "Reframing Organizations," by L. G. Bolman & T.E. Deal, 2013. Copyright by L. G. Bolman & T.E. Deal.

Leadership instrument reliability. Spearman Brown coefficients and Cronbach's alpha values for each of the leadership frame areas appear in Table 8 along with the number of cases analyzed for each value. Cronbach's alpha values were recalculated for these four frame measurement areas in the current study.

Leadership instrument validity. In addition to Phillips (2012) and Phillips and Baron (2013), Bolman and Deal's instrument has been used by the authors themselves in six published studies, by other authors in two books and in forty published studies, and by doctoral candidates in over 50 dissertations, nearly all of which deal with the leadership frame construct (Bolman, 2010). These studies took place over a 20-year time period from 1990 to 2010 (Bolman, 2010). In order to ensure thoroughness for this

study, a first order CFA was performed to assess the construct validity of Bolman and Deal's instrument. Model fit as well as convergent and discriminant validity were assessed.

Table 8

Leadership Frame Instrument Reliability Statistics

Measurement Areas	Questions	Cases	Spearman-Brown	Cronbach α
Structural Frame	8	1309	933	.920
Human Resources Frame	8	1331	929	.931
Political Frame	8	1268	911	.913
Symbolic Frame	8	1315	937	.931

Note. Adapted from "Research Using Leadership Orientations Survey Instrument," by L.G. Bolman, 2010. Copyright by L. G. Bolman.

Treatment of the Data

The aviation manager for each organization that participated was provided a survey link at www.surveymonkey.com unique to his or her organization. The aviation manager was then asked to forward the link to all of the personnel in the organization. Sixty-nine aviation managers did not forward the link, 112 did. Each of the 980 respondents participated anonymously through the assigned link. While the Survey Monkey website does collect internet protocol address data, that information was discarded. One question on the instrument collected demographic data on the respondent's level in the organization, but no other individual information was solicited. While data was grouped by operator due to the issuance of separate links for each

organization participating, no internal matching or correlation took place once the data was entered into the SPSS software.

Descriptive statistics. The 57 quantitative variables generated by the instrument were analyzed for univariate mean, standard deviation, mode, skew, and kurtosis. Frequency histograms were generated to provide a visual depiction of the distribution of the data. Multivariate kurtosis was also calculated.

Missing Data. The design of the instrument was such that it should have forced completion of all required questions once attempted by the respondent. The design did not, however, prevent survey participants from exiting the survey once underway. Of the 980 responses received, 134 were discarded due to respondents either not agreeing with the informed consent statement at the beginning of the survey or partially completing the survey and then exiting the survey once underway. The remaining number of usable responses was 846.

Non-response Bias. Non-response bias occurs when the non-response rate for a survey is substantial enough that those who do respond may not constitute a representative sample of the targeted sampling frame (Vogt, Gardner, & Haeffele, 2012). Typically, there are three reasons for non-response in survey research: 1) potential respondents never receive the survey, 2) respondents cannot complete the survey because they don't have the required data, or 3) respondents refuse to complete the survey (Groves et al., 2009). Of these three reasons, the last one is the most difficult for researchers to deal with because of the potential effect on the variables of interest

(Groves et al., 2009). Unfortunately, there appears to be no consolidated agreement among research experts as to the level of response in which non-response bias can be ignored, with some experts arguing that 50% response is sufficient while other maintain that 85% is minimally adequate (Groves et al., 2009).

The most effective method to deal with non-response bias is for the researcher to do everything he or she can to maximize response and minimize non-response in the first place (Vogt, Gardner, & Haeffele, 2012). Mechanisms to minimize nonresponse can include thorough pre-test of survey instruments, avoiding rushed or short data-collection periods, sending reminders to potential respondents, ensuring confidentiality of respondents, or offering incentives to respondents (Penwarden, 2013). For this study, nearly all of these mechanisms were incorporated. The safety culture perceptions instrument was pre-tested twice and the leadership performance instrument was used in multiple scholarly studies. The data collection period was extended from one to two months to ensure adequate time for response. Multiple general reminders were sent to all aviation mangers from IBAC and multiple individual reminders were sent to aviation managers by the researcher. Individual and organization confidentiality was emphasized in all communications as was the assurance that no group data for participating organizations would be presented. The only incentive offered was possibility of contributing to the safety of the business aviation industry and to the improvement of the IS-BAO, both of which were emphasized by IBAC in its communication.

Once the data was collected, nonresponse bias needed to be addressed at both the operator and respondent level. Both of these tasks were challenging. At the operator level, while IBAC's sponsorship of the study made the request for operator participation

more official, the choice as to whether or not to participate was made by the applicable aviation manager. Of the 566 U.S. IS-BAO-registered operators listed in IBAC's roster, four operators' registrations had lapsed, making them ineligible to participate. An additional 13 operators were not contacted because they had either ceased operations or their contact information in IBAC's database was not current. Of the remaining 549 operators, 181 chose to participate, and one refused to participate based on the current workload of the organization's personnel. The remaining 367 operators not only did not participate, but also did not respond to communications from either IBAC or the researcher in spite of multiple attempts at communication.

At the individual respondent level, lack of response was assumed to be generated by respondent refusal to participate since the survey was distributed to respondents electronically via email and since nearly all members of business aviation organizations are required to possess and be knowledgeable in the use of computer technology. Most business aviation professionals maintain dynamic schedules and travel extensively, so refusal to participate may have been as much a function of task prioritization as it was the manifestation of a particular attitude or opinion. The phenomenon of survey burnout may have also contributed to respondent refusal to participate.

Imputation of survey values for non-respondents was difficult to perform with a consistent methodology. Values for non-respondents in organizations that did not participate could not be estimated because there is no database where the type of information collected by this instrument had been previously sampled. Values for non-respondents inside participating organizations could have been estimated, but for 69 operators there was only one respondent for the entire organization, and the number of

respondents for the other 112 operators varied considerably. Hence, the calculation of organizational averages as values for imputation would not have been consistent and could have resulted in skewed data.

Sampling bias appears to have been limited, if present at all. While the pre-tests were conducted with small, all volunteer populations of IS-BAO-registered operators with the encouragement of the applicable aviation manager, this study targeted the entire population of U.S. IS-BAO-registered operators. There was some limited overlap between the two populations. Chi-squared tests for independence were conducted on three demographic characteristics for the pre-test and current study populations. The chi-squared tests showed that the two populations were homogenous in the areas of IS-BAO stage ($X^2 = 3.51$, $p = .173$) and employee levels ($X^2 = 3.35$, $p = .187$) but were heterogeneous in the area of number of years IS-BAO ($X^2 = 102.68$, $p = .000$). This would seem to indicate that respondents and non-respondents, both at the organizational and individual levels, were not markedly different.

Assumptions. The most critical assumption for the application of multivariate statistical analysis techniques is that of univariate and multivariate normality and associated limited values of skewness and kurtosis (Hair, Black, Babin, & Anderson, 2010). However, where survey instruments are concerned, particularly those using Likert scales, both skewness and kurtosis are somewhat common (Byrne, 2010) and were assessed as part of the analysis. Fortunately, the effects of non-normal distributions can be negligible as sample size becomes larger (Hair et al., 2010).

While outliers would not seem to be an issue given the expected kurtosis for survey instruments using Likert scales, especially the five-item Likert scale on the survey instrument used for this study, a standard test for multivariate outliers, the squared Mahalanobis distance (D^2), was computed for each variable case. Typically, an outlying case will have a D^2 value that is distinctly different from other D^2 values (Byrne, 2010). Using the conservative thresholds discussed by Hair et al. (2010) and Kline (2011), 75 cases in the current study that demonstrated D^2 values that were distinctly different (4 or greater) and with associated *p* values less than .001 were excluded from analysis. This left 771 cases for analysis in the current study.

Construct Validity Assessment. The CFA models for the safety culture and leadership performance constructs as well as the SEM itself were analyzed for goodness-of-fit (GOF) before the hypotheses tests were conducted. All data was analyzed using IBM's SPSS AMOS software, version 23. The 771 cases analyzed satisfied the minimum sample size to validate the model structure as specified by Westland (2010). Model GOF was assessed using the GOF statistics and criteria in Table 9. Although there is some divergence in SEM literature where the appropriateness of fit statistics and associated criteria are concerned, there was general agreement in Byrne (2010), Kline (2011), and Garson (2015) about the criteria used in Table 9 and throughout this study.

Table 9

CFA and SEM GOF Statistics and Criteria

GOF Statistic	Abbreviation	Fit Criteria
X^2 to degrees-of-freedom ratio	CMIN/df	< 3 = good fit
Goodness-of-fit index	GFI	> .9 = adequate fit > .95 = good fit
Adjusted goodness-of-fit index	AGFI	> .9 = adequate fit > .95 = good fit
Root mean square error of approximation statistic	RMSEA	< .05 = good fit
Comparative fit index	CFI	> .9 = adequate fit > .95 = good fit
Normed fit index	NFI	> .9 = adequate fit > .95 = good fit

Post hoc analyses using modification indices calculated by the AMOS software were required to adapt the CFA models and the SEM to better fit the data. Byrne (2010) discussed the use of modification indices associated with covariances to re-specify the model when the addition of covariances make sense within the context of the model. Garson (2015) recommended limiting the addition of covariances to intra-factor variables. In the post hoc analyzes conducted on the CFAs and the SEM, modification indices selected to re-specify the models were limited to those associated with intra-factor covariances only.

Convergent validity and discriminant validity were assessed for the CFAs. Convergent validity was assessed using the factor loadings on construct elements and the average variance extracted (AVE) per Hair et al. (2010) and through scale reliability per Garson (2010) and Hair et al. (2010). Discriminant validity was assessed through change

in model fit per Byrne (2010) and comparison of AVE versus average squared correlation values per Hair et al. (2010).

Hypothesis Testing. Once model fit, convergent validity, and divergent validity were assessed, the hypotheses were tested using the SEM and evaluating the regression weights for the applicable paths. If the standardized regression weight was positive and significant at $p = .05$ or less, the null hypothesis was rejected. The hypotheses are listed below, and their applicability to the SEM is illustrated in Figure 2.

H_{10} – There is no significant relationship between IS-BAO progression and safety culture perceptions.

H_{1A} – The relationship between IS-BAO progression and safety culture perceptions is positive and significant.

H_{20} – There is no significant relationship between leadership performance in the structural frame and safety culture perceptions.

H_{2A} – The relationship between leadership performance in the structural frame and safety culture perceptions is positive and significant.

H_{30} – There is no significant relationship between leadership performance in the human resources frame and safety culture perceptions.

H_{3A} – The relationship between leadership performance in the human resources frame and safety culture perceptions is positive and significant.

H_{40} – There is no significant relationship between leadership performance in the political frame and safety culture perceptions.

H_{4A} – The relationship between leadership performance in the political frame and safety culture perceptions is positive and significant.

H_{50} – There is no significant relationship between leadership performance in the symbolic frame and safety culture perceptions.

H_{5A} – The relationship between leadership performance in the symbolic frame and safety culture perceptions is positive and significant.

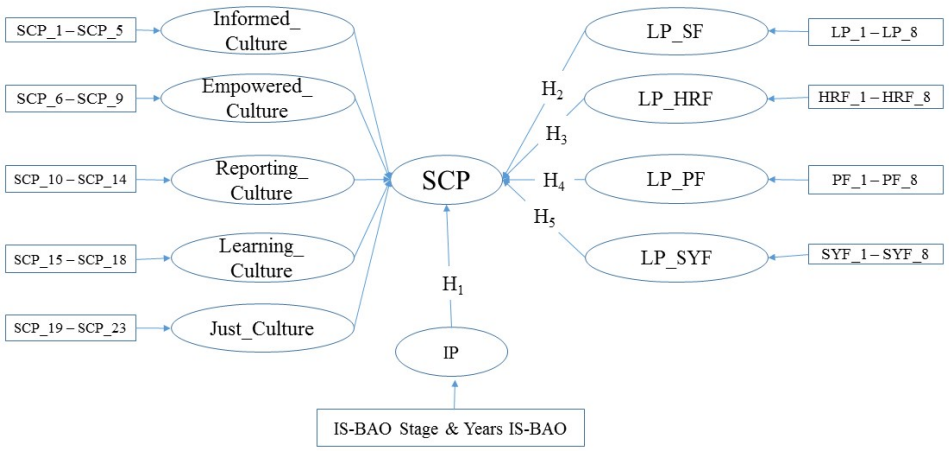


Figure 2. Simplified SEM with Hypotheses Annotated. Notation has been adapted to reflect variable flow. The notation is not consistent with that used in AMOS SEM modeling diagrams. The full SEM appears in Appendix F.

Ethics and IRB Considerations. An IRB application for human subjects testing was submitted and approval received prior to data collection for this study (See Appendix E). The electronic submission and collection mechanism (www.surveymonkey.com) did provide some identifying data for respondents, but that data was discarded. The researcher did agree to provide the aviation managers of the organizations that

participated summary data of their organization's average scores versus the overall averages. Respondents were advised that organizational averages and overall averages would be provided to their aviation manager.

Summary

While the technical description of methodology used in the current study is important, the purpose and intentions behind the methodology should not be overlooked as part of that discussion. The quantity of data received, the quality of data generated, and the thoroughness of the analysis performed all contributed to the overall objective of the study: the examination and comparison of the effects of IS-BAO progression and leadership performance on safety culture perceptions.

While the sampling mechanism did not operate as envisioned or provide as large a representation of the U.S. IS-BAO-registered operator population as expected, the results received probably reflected the population sufficiently and were definitely adequate to validate the structures of the CFAs and SEM. Hence, the quantity of data generated was likely sufficient to measure the effects of IS-BAO progression and leadership performance on safety culture perceptions.

The safety culture and leadership performance assessment instruments used to generate the data received were pretested and validated in previous studies before their use in the current study. The methodology described was built, in part, to test and validate the safety culture and leadership performance constructs again in the current study. The previous and current tests ensure the quality of data generated was sufficient

to measure the effects of IS-BAO progression and leadership performance on safety culture perceptions.

With sufficient quantity and quality of data, the methodology discussed allows for tests of the hypotheses that actually measure the effects of IS-BAO progression and leadership performance on safety culture perceptions. The results of that methodology are presented in the next section.

CHAPTER IV

RESULTS

Data Preparation

As previously discussed, of the 980 responses or cases received, 134 were deleted because the respondent did not consent and opted out of the survey, or the respondent completed only the safety culture perceptions portion of the survey and did not complete the leadership performance portion. The remaining 846 cases were analyzed for multivariate outliers and 75 cases with D^2 values 4 or greater with associated *p* values less than .001 were discarded for analysis in the final SEM model, leaving a total of 771 respondent cases for examination.

Participants

The 771 respondents that generated the cases for examination were employees of 156 U.S. IS-BAO-registered operators. Of these 156 operators, 51 had only one respondent, the person who received the survey link, and 105 had multiple respondents because the link was forwarded throughout the department. The majority of the responding operators, 127 of 156 or 81.4%, were corporate flight departments operating under 14 C.F.R. Part 91. The remaining 29 operators (18.6%) operated under 14 C.F.R. parts 135, 141, and 125. The proportion of the IS-BAO Stages of the respondent organizations appears at Figure 3. The years that the operators were IS-BAO-registered ranged from a low of less than one year to a maximum of 14 years, and the distribution appears at Figure 4. The distribution of employee levels among the individual respondents appears at Figure 5.

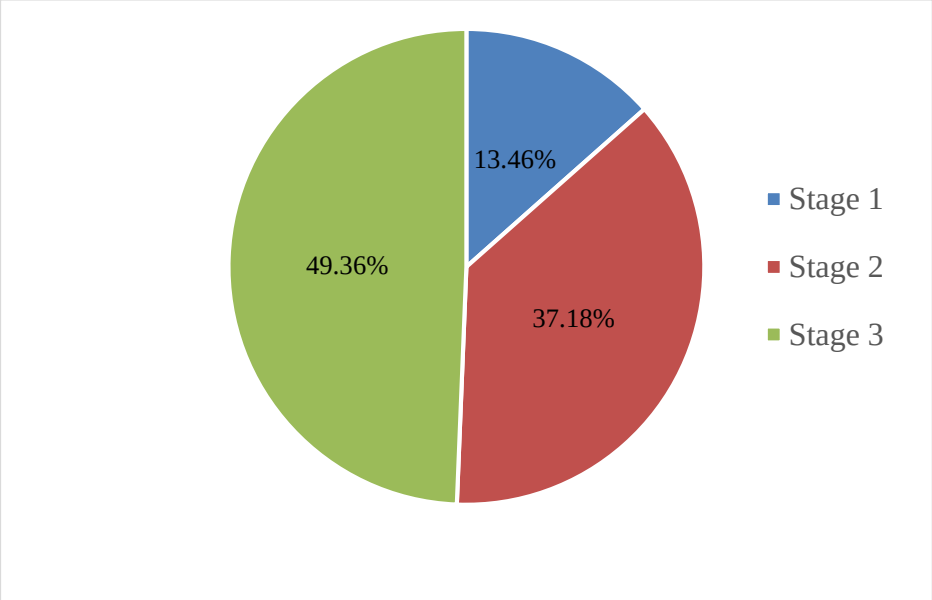


Figure 3. Operator proportion vs IS-BAO registration stage

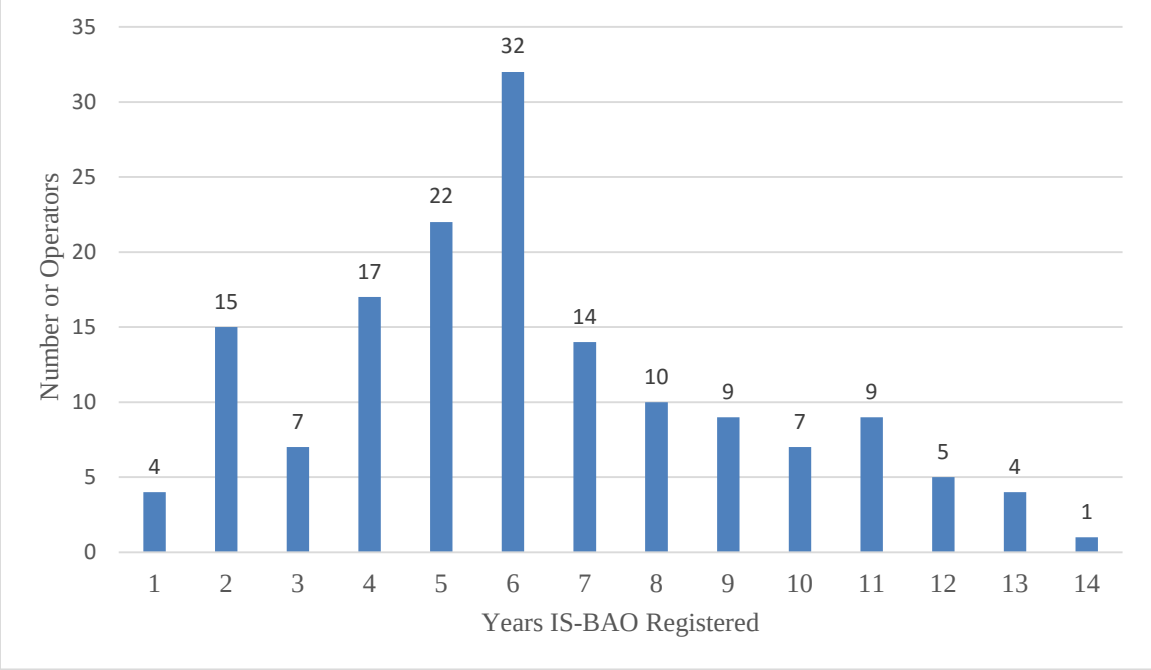


Figure 4. Operator distribution over years IS-BAO registered

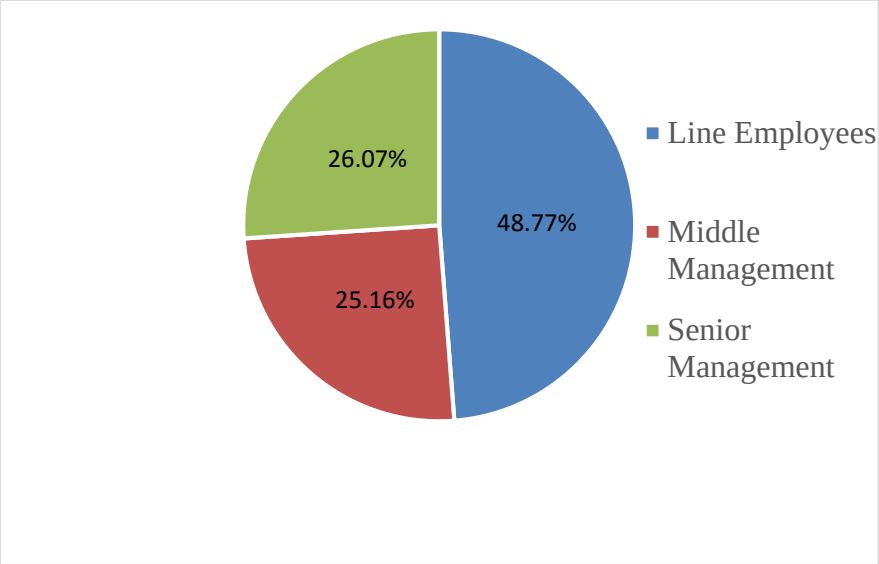


Figure 5. Individual respondent employee level. Line employees were defined as flight crew members, technicians, or schedulers; middle managers were defined as standards captains or lead technicians; and senior management was defined as chief pilots, directors of maintenance, and directors of aviation.

Descriptive Statistics

Descriptive statistics for the IS-BAO and safety culture perceptions variables appear in Table 11. Descriptive statistics for the leadership performance variables appear in Table 12. IS-BAO Stage was limited to the values of 1, 2, or 3. Years IS-BAO-registered could assume any integer value of 1 or above. The remaining values were derived from a Likert Scale that generated a score value from 1 to 5. Questions that were negatively phrased were reverse-coded so greater positive values were generated for more negative responses. The mean values of the SC and LP variables represent the average participant response to the questions presented in Appendix A.

One of the most important criteria for both CFA and SEM using the maximum likelihood method of estimation is for the data to be multivariate normal, particularly where the multivariate kurtosis of the sample is concerned (Byrne, 2010).

The univariate kurtosis for each variable in Tables 11 and 12 is less than 7, the maximum recommended value (Byrne, 2010). Multivariate kurtosis was a bit more complicated to assess because it had to be measured in three different constructs. While Byrne (2010) stated that a critical ratio of multivariate kurtosis greater than 5 means that there is multivariate non-normality present in the data, Hair et al. (2010) argued that the effects of multivariate non-normality can by mitigated by larger sample sizes. The generally accepted ratio to minimize those effects is 15 respondents for each variable tested (Hair et al., 2010). The critical ratios of multivariate kurtosis for the first order CFAs for SCP and LP as well as for the SEM are presented in Table 10. While all the ratios are above 5, the maximum value recommended by Byrne (2010), the number of cases/respondents analyzed, 771, is greater than the minimum ratio required to mitigate the effects of multivariate non-normality for both the SCP and LP CFAs, but not greater than that required for the SEM. Hence, some multivariate non-normality may exist in the data and may generate some bias in the results.

Table 10

Multivariate Kurtosis Summary for Study Constructs

Construct	Critical Ratio of Multivariate Kurtosis	Number of Variables	Minimum Cases to Overcome Multivariate Non-Normality
SCP CFA	68.95	23	345
LP CFA	75.05	32	480
SEM	74.26	57	855

Note. 771 cases analyzed. Minimum cases computed per Hair et al. (2010), 15 cases or respondents for each variable analyzed.

Table 11

Descriptive Statistics for IS-BAO and Safety Culture Perceptions Variables

Variable	Mean	Std. Deviation	Mode	Skewness	Skewness Critical Ratio	Kurtosis	Kurtosis Critical Ratio
IS_Stage	2.423	0.719	3	-0.829	-9.403	-0.638	-3.616
IS_Years	6.497	3.252	6	0.33	3.741	-0.479	-2.714
SCP_1	4.23	.716	4	-.922	-10.447	1.734	9.826
SCP_2	4.45	.727	5	-1.645	-18.644	3.873	21.949
SCP_3	4.13	.941	4	-1.271	-14.407	1.447	8.201
SCP_4	4.20	.745	4	-.944	-10.698	1.436	8.141
SCP_5	3.73	.971	4	-.818	-9.275	.207	1.173
SCP_6	3.86	1.005	4	-.817	-9.258	.209	1.186
SCP_7	4.15	.801	4	-.967	-10.960	1.237	7.009
SCP_8	4.17	.851	4	-1.095	-12.410	1.276	7.234
SCP_9	4.29	.875	5	-1.360	-15.418	1.809	10.254
SCP_10	4.15	.755	4	-.800	-9.068	.765	4.338
SCP_11	4.34	.826	5	-1.456	-16.509	2.350	13.318
SCP_12	3.68	.931	4	-.525	-5.950	-.241	-1.368
SCP_13	4.09	.866	4	-.974	-11.041	.815	4.617
SCP_14	4.01	.819	4	-.825	-9.348	.784	4.446
SCP_15	4.23	.829	4	-1.207	-13.678	1.525	8.644
SCP_16	4.30	.743	4	-1.273	-14.435	2.632	14.919
SCP_17	4.00	.762	4	-.813	-9.217	1.138	6.451
SCP_18	4.20	.887	4	-1.423	-16.126	2.375	13.459
SCP_19	3.76	1.115	4	-.734	-8.316	-.319	-1.81
SCP_20	3.99	.968	4	-1.097	-12.438	.977	5.535
SCP_21	4.08	.862	4	-1.035	-11.730	1.132	6.417
SCP_22	4.15	.854	4	-.946	-10.729	.721	4.085
SCP_23	3.85	.813	4	-.671	-7.606	.784	4.443

Note. N=771 for all variables.

Table 12

Descriptive Statistics for Leadership Performance Variables

Variable	Mean	Std. Deviation	Mode	Skewness	Skewness Critical Ratio	Kurtosis	Kurtosis Critical Ratio
SF_1	4.06	.895	4	-.931	-10.554	.641	3.634
SF_2	4.03	.888	4	-.979	-11.098	1.022	5.795
SF_3	4.13	.915	4	-1.071	-12.141	.888	5.03
SF_4	3.98	.903	4	-.933	-10.579	.815	4.618
SF_5	4.16	.889	4	-1.101	-12.476	1.025	5.808
SF_6	3.95	.952	4	-.800	-9.069	.233	1.32
SF_7	4.06	.965	5	-.893	-10.124	.176	0.997
SF_8	4.12	.915	4	-1.115	-12.634	1.102	6.244
HRF_1	4.10	.969	5	-.970	-10.995	.325	1.842
HRF_2	3.93	1.059	4	-.970	-10.996	.282	1.599
HRF_3	3.93	1.022	4	-.783	-8.872	-.070	-0.399
HRF_4	3.88	1.029	4	-.818	-9.278	.083	0.473
HRF_5	4.07	.914	4	-.967	-10.967	.686	3.89
HRF_6	3.91	1.030	4	-.825	-9.355	.012	0.071
HRF_7	4.03	.974	4	-.878	-9.958	.154	0.871
HRF_8	4.05	1.001	5	-.970	-10.991	.264	1.497
PF_1	4.01	.922	4	-.867	-9.832	.403	2.283
PF_2	3.66	1.007	4	-.526	-5.965	-.259	-1.467
PF_3	3.53	1.047	4	-.458	-5.193	-.324	-1.834
PF_4	3.70	.960	4	-.643	-7.285	.214	1.211
PF_5	3.85	.958	4	-.752	-8.522	.221	1.253
PF_6	3.80	.985	4	-.791	-8.966	.318	1.8
PF_7	3.86	1.011	4	-.807	-9.154	.252	1.428
PF_8	3.88	.873	4	-.868	-9.838	.865	4.904
SYF_1	4.00	1.036	5	-.989	-11.206	.382	2.166
SYF_2	3.55	1.080	4	-.463	-5.253	-.455	-2.578
SYF_3	3.66	1.061	4	-.646	-7.325	-.195	-1.108
SYF_4	3.69	1.010	4	-.556	-6.299	-.195	-1.104
SYF_5	3.99	.968	4	-.902	-10.223	.362	2.054
SYF_6	3.71	1.026	4	-.634	-7.185	-.038	-0.215
SYF_7	3.85	1.050	4	-.855	-9.692	.057	0.322
SYF_8	3.95	1.030	4	-.957	-10.848	.437	2.475

Note. N=771 for all variables.

Reliability Testing

Table 13 presents the scale reliability for all of the constructs and scales used in the study. While unstandardized and standardized values of Cronbach's α were calculated for all scales, the standardized values are most applicable for the two data items used to calculate IS-BAO progression since the data items have different measurement scales. The standardized values for all scales are well above the accepted minimum of .7 (Field, 2013), hence the scale reliability for all constructs used in the study may be considered adequate.

Table 13

Study Construct Scale Reliability

Measurement Area	Variables	α – unstandardized	α – standardized
IS-BAO Progression	2	.477	.852
The Informed Culture	5	.775	.789
The Empowered Culture	4	.758	.760
The Reporting Culture	5	.813	.813
The Learning Culture	4	.805	.809
The Just Culture Scale	5	.864	.868
Safety Culture Perceptions	23	.948	.949
The Structural Frame	8	.939	.940
The Human Resources Frame	8	.956	.956
The Political Frame	8	.920	.921
The Symbolic Frame	8	.955	.955
Leadership Performance	32	.982	.983
All Assessed Variables	55	.982	.982

Validity Testing

Construct validity was evaluated by assessing convergent and discriminant validity for the first order CFA on the leadership performance construct and the first order CFA on the safety culture perceptions construct. A second order CFA linking the leadership performance and safety culture perceptions constructs was necessary to further test for discriminant validity. GOF statistics were evaluated for all models.

Leadership Performance Construct CFA. To demonstrate the construct validity of Bolman and Deal's Leadership Frames assessment instrument and its associated measurement of leadership performance, a first order CFA was performed on the construct. One post hoc analysis was performed using modification indices associated with intra-factor error terms.

The final GOF values generated by the AMOS software confirmed acceptable to good model fit in all but one indicator, adjusted goodness-of-fit (AGFI). Table 14 shows the pre and post hoc GOF statistics for the Leadership Performance CFA. The final CFA model appears at Appendix I.

The leadership performance construct validity assessment statistics appear in Table 15. The construct displayed strong convergent validity. Scale reliability for all constructs was greater than .7 (Hair et al., 2010). All standardized factor loadings and all AVE values were greater than .5 (Hair et al., 2010). Discriminant validity was more difficult to assess. The model fit improved with the post hoc analysis and demonstrated positive changes in GOF criteria (Byrne, 2010) (Table 14), demonstrating some evidence

of discriminant validity. But the squared correlation values for factor loadings were greater than the AVE values, not less (Hair et al., 2010), demonstrating evidence of a lack of discriminant validity. Given these conflicting results, the model did not seem to provide enough evidence to evaluate discriminant validity.

Table 14

Leadership Performance Construct CFA GOF Statistics

GOF Statistic	Criteria	First Run Value	Final Run Value
CMIN/df	< 3	3.532	2.669
GFI	>/= .9 - .95	.867	.908
AGFI	>/= .9 - .95	.846	.888
RMSEA	< .05	.057	.047
CFI	>/= .9 - .95	.954	.971
NFI	>/= .9 - .95	.937	.955

Table 15

Leadership Performance Construct CFA Validity Statistics

Subconstruct	Scale Reliability α	AVE	Subconstruct Correlation	Squared Correlation Value
LP_SF	.940	.644	LP_SF vs LP_SYF	.893
LP_HRF	.956	.722	LP_PF vs LP_SYF	.943
LP_PF	.921	.567	LP_HRF vs LP_SYF	.974
LP_SYF	.955	.725	LP_HRF vs LP_PF	.876
			LP_SF vs LP_PF	.929
			LP_SF vs LP_HRF	.887

Note. Subconstruct descriptions appear in Table 5.

Safety Culture Perceptions Construct CFA. To demonstrate the construct validity of the safety culture perceptions assessment instrument, a first order CFA was performed on the construct. Two post hoc analyses were performed using modification indices associated with intra-factor error terms.

The final GOF values generated by the AMOS software for the safety culture perceptions construct confirmed acceptable to good model fit. Table 16 shows the pre and post hoc GOF statistics for the safety culture perceptions CFA. The final CFA model appears at Appendix J.

Table 16

Safety Culture Perceptions Construct CFA GOF Statistics

GOF Statistic	Criteria	First Run Value	Final Run Value
CMIN/df	< 3	3.786	2.853
GFI	>/= .9	.908	.933
AGFI	>/= .9	.884	.912
RMSEA	< .05	.06	.049
CFI	>/= .95	.935	.959
NFI	>/= .9	.914	.938

Safety culture perceptions construct validity statistics appear in Table 17. The construct displayed adequate convergent validity. Scale reliability for all constructs was greater than .7 (Hair et al., 2010). Nearly all standardized factor loadings were greater than .5, but only two of five AVE values were greater than .5 (Hair et al., 2010). Similar

to the leadership performance construct, discriminant validity was challenging to assess for the safety culture perceptions construct. The model fit improved with the post hoc analysis and demonstrated a positive change in GOF criteria (Table 15), demonstrating some evidence of discriminant validity (Byrne, 2010) but the squared correlation values for factor loadings were greater than the AVE values, not less, demonstrating evidence of a lack of discriminant validity. Thus the safety perceptions construct did not provide sufficient evidence to evaluate discriminant validity.

Table 17

Safety Culture Perceptions Construct CFA Validity Statistics

Subconstruct	Scale Reliability α	AVE	Subconstruct Correlation	Squared Correlation Value
IC	.789	.416	IC vs JC	.778
EC	.760	.384	IC vs LC	.916
RC	.813	.441	IC vs RC	.863
LC	.809	.521	IC vs EC	.922
JC	.868	.558	EC vs JC	1.01
			EC vs LC	1.01
			EC vs RC	1.04
			RC vs JC	.947
			RC vs LC	1.03
			LC vs JC	.815

Note. Subconstruct names abbreviated for space. IC = Informed Culture, EC = Empowered Culture, RC = Reporting Culture, LC = Learning Culture, JC = Just Culture

Second Order Leadership Performance and Safety Culture Perceptions

CFA. Due to the lack of evidence to evaluate discriminant validity in the leadership performance and safety culture perceptions constructs and because the design of the SEM has the safety culture perceptions factors loading onto a second order construct, a second order CFA, combining the leadership performance and safety culture perceptions constructs, was devised in order to determine if the two second order constructs were truly discrete. The second order model linked the final versions of the leadership performance CFA and the safety culture perceptions CFA, and no post hoc analyses were performed.

In this model, the AVE values for the standardized factor loadings onto the second order constructs were .966 and .956 for the safety culture perceptions and leadership performance constructs, respectively. The squared correlation between the two was .600, which is less than both AVE values. The second order construct demonstrates both convergent and discriminant validity.

The model appears at appendix K and the GOF statistics appear at Table 18. The combined model demonstrated adequate to good fit in all statistics except goodness-of-fit index (GFI) and AGFI, which demonstrated mediocre but acceptable fit.

Table 18

Second Order Leadership Performance and Safety Culture Perceptions CFA GOF Statistics

GOF Statistic	Criteria	Value
CMIN/df	< 3	2.137
GFI	>/= .9 - .95	.863
AGFI	>/= .9 - .95	.848
RMSEA	< .05	.038
CFI	>/= .9 - .95	.956
NFI	>/= .9 - .95	.92

Hypothesized SEM. With construct validity demonstrated for the leadership performance and safety culture perceptions constructs, the next step in the analysis was to assess the GOF for the hypothesized SEM which combined the two constructs (Appendix F). The initial analysis in the AMOS software showed adequate to good fit in all but two GOF indices, GFI and AGFI. Post hoc analyses were performed which used modification indices associated with intra-factor covariances only. The final version appears at Appendix L. With all intra-factor modification indices applied, GOF values improved, but GFI and AGFI remained below the conventionally-accepted thresholds (Table 19).

Table 19

Hypothesized SEM GOF Statistics

GOF Statistic	Criteria	First Run Value	Final Run Value
CMIN/df	< 3	2.450	1.901
GFI	>/= .9 - .95	.834	.878
AGFI	>/= .9 - .95	.819	.862
RMSEA	< .05	.043	.034
CFI	>/= .9 - .95	.939	.964
NFI	>/= .9 - .95	.902	.927

Byrne (2010) argues that GFI and AGFI are very sensitive to sample size. Kline (2011) states that mean values of GFI can actually increase as sample size increases and GFI values can fall outside of the 0 - 1.0 range, making them meaningless. Sharma et al. (2005) conducted an extensive study of model fit indices and concluded GFI was an unreliable index and should not be used. Garson (2015) argues that GFI and AGFI are biased downward when degrees of freedom are large relative to sample size. Table 18 compares the GFI and AGFI values for the leadership performance construct CFA, the safety culture perceptions construct CFA, and the SEM along with the associated degrees of freedom for each model and shows that it is possible that both indices were biased downward in the GOF statistic calculations for the SEM. Garson (2015) said that given their susceptibility to sample size and degrees of freedom limitations, many researchers no longer report GFI and AGFI when assessing model GOF. In the current model with 771 respondents and 1,464 degrees of freedom, given that the values of CMIN/df, RMSEA, CFI, and NFI are at or above the conventionally accepted thresholds for model

fit and given the limitations on GFI and AGFI when degrees of freedom are large relative to sample size, it is concluded that the GOF measures demonstrate adequate fit for the SEM and the data analyzed.

Table 20

Comparison of Model GFI and AGFI Values and Degrees of Freedom

Model	Degrees of Freedom	GFI Value	AGFI Value
Safety Culture Perceptions CFA	211	.933	.912
Leadership Performance CFA	432	.908	.888
SEM	1464	.878	.862

Hypothesis Testing

The simplified SEM model in Figure 6 shows the standardized regression weights associated with each of the paths tested by the hypotheses in this study. Regression weights with asterisks are significant at $p < .05$ or better. Hypothesis test results are summarized in Table 21.

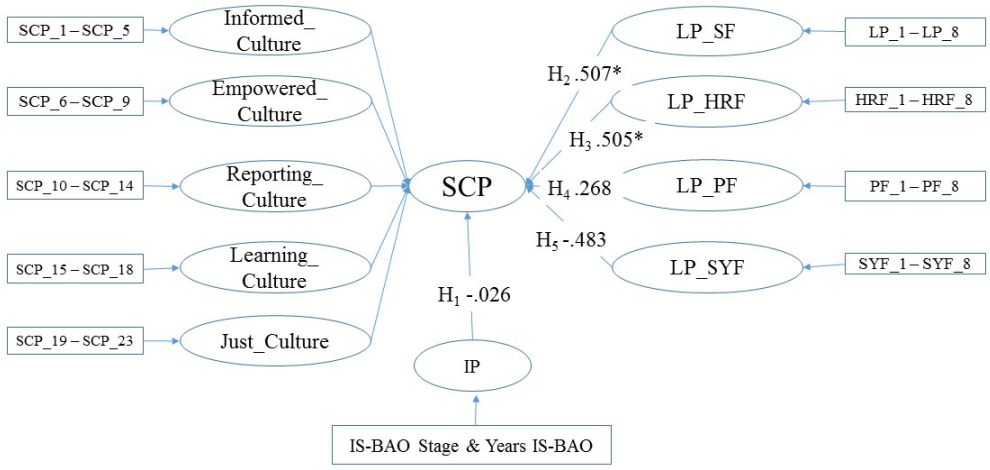


Figure 6. Simplified SEM model with hypotheses and standardized regression weights. Notation has been adapted to reflect variable flow. The notation is not consistent with that used in AMOS SEM modeling diagrams. Actual hypothesized SEM model appears at Appendix F.

Given the data analyzed and the model presented, IS-BAO progression, leadership performance in the political frame, and leadership performance in the symbolic frame did not positively and significantly affect safety culture perceptions in the IS-BAO-registered organizations that were examined. In contrast, leadership performance in the structural frame and leadership performance in the human resources frame did positively and significantly affect safety culture perceptions in those organizations. The impact of these results will be discussed in the next section.

Table 21

Hypothesis Test Results

Hypothesis (Relationship between two items positive and significant)	Standardized Regression Weight	*p* value	Hypothesis Supported?
1 - IS-BAO Progression & SCP	-.026	.933	No
2 - Leadership Performance in the Structural Frame & SCP	.507	.013	Yes
3 - Leadership Performance in the Human Resources Frame & SCP	.505	.002	Yes
4 - Leadership Performance in the Political Frame & SCP	.268	.405	No
5 - Leadership Performance in the Symbolic Frame & SCP	-.483	.095	No

Note: SCP = safety culture perceptions

CHAPTER V

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This research was the first scientific study conducted into the effects of both IS-BAO progression and leadership performance on safety culture perceptions in the field of business aviation. It was also the first study to examine and compare the effects of SMS implementation, through IS-BAO, with the effects of leadership on the safety culture of private corporate operators operating under 14 C.F.R. Part 91, a group that constituted a large majority of the IS-BAO-registered operators who participated. The overall results were somewhat mixed. In some respects, the results of this study seemed to echo the conclusions of much of the literature surveyed, in that the leadership of aviation organizations had a significant impact on the safety culture of those organizations. But the study results also seemed to contrast much of the literature in that SMS implementation, through IS-BAO and over time, seemed to have no impact on safety culture whatsoever.

In the paragraphs to follow, the overall reliability and validity of the model will be discussed, the results of each hypothesis test will be examined in detail, and possible conclusions from those results will be discussed. Some overall conclusions will be discussed as well. Finally, recommendations for further research will be presented.

Discussion and Conclusions

Reliability Analysis. The results of the reliability analysis (Table 13) were largely unsurprising although the two-item scale for IS-BAO Progression proved more reliable than anticipated given the standardized α value of .852. The scale reliability

values for the safety culture perceptions constructs were better than those generated by the pre-tests, and the values for the leadership performance constructs were better than the historical averages provided by Bolman (2010). The overall scale reliability for all safety culture perceptions values, all leadership performance values, and all values combined were well above the required minimum. The overall instrument and its associated sub-constructs were considered reliable and generated similar results among the respondents participating in the study.

Validity Analysis. The leadership performance and safety culture perceptions CFAs both demonstrated convergent validity. With the addition of the second order CFA which linked both constructs, discriminant validity was demonstrated as well. The leadership performance CFA, safety culture perceptions CFA, and SEM demonstrated adequate model fit, given the limitations on GFI and AGFI as discussed earlier. In short, the hypothesized model demonstrated adequate construct validity and was suitable to test the hypotheses that were the basis of this research.

Hypothesis Tests and Conclusions. The purpose of this study was to examine and compare the effects of IS-BAO progression and leadership performance on the perceptions of safety culture in IS-BAO-registered business aviation organizations. The results from the hypothesis tests showed mixed results in the examination of those effects.

H_1. H_{1A} hypothesized that the relationship between IS-BAO progression and safety culture perceptions would be positive and significant; specifically, that as an

organization matures through the three stages of registration and spends more time under IS-BAO, more time under a safety management system, the health of the organization's safety culture, as measured by the perceptions of those in it, will improve. Given previous studies, particularly McNeely (2012), this improvement in safety culture perceptions seemed to be a logical conclusion. According to the SEM model and the data, this relationship was not significant; i.e. statistically, no relationship exists. This result is somewhat surprising for while the literature was somewhat divided on whether safety culture was a precondition for or a product of SMS implementation, none of the literature indicated that SMS implementation, in and of itself, had no impact on the safety culture at all. Yet previous studies did not attempt to measure the impact of IS-BAO / SMS progression on safety culture simultaneously with the impact of leadership performance on safety culture, so while the effect of IS-BAO / SMS progression on safety culture is not significant in this study, it may be that the effect of IS-BAO / SMS progression on safety culture is simply overshadowed by the effect of leadership performance on safety culture when the two are measured alongside one another. Another possible conclusion may be that the success of the SMS where safety culture is concerned is more about the leadership that implements the SMS than that success is about the SMS itself.

H_2. H_{2A} hypothesized that the relationship between safety culture perceptions and leadership performance in the structural frame would be positive and significant, and this hypothesis was supported in the context of the SEM and the data analyzed. According to Bolman and Deal (2013), the structural frame of leadership is about the structure of the organization and the environment in which the organization operates. The structural

frame also encompasses roles, goals, policies, and the use of technology (Bolman & Deal, 2013). The structural construct corresponds well to the safety policies and objectives element in the FAA's (2010) framework for SMS, one of the pillars of an effective SMS as the FAA describes it. The results from this hypothesis would seem to echo the literature reviewed in that for a safety culture to be healthy, leadership must establish and maintain a sound structure in which the culture may exist and in which the SMS may operate. The strength of the standardized regression weight for this particular leadership frame, .507, is impressive. For each one-unit improvement in leadership in the structural frame, safety culture perceptions increase over .5 units. This conclusion speaks to the importance of leadership that clearly defines the policies and procedures that surround not only the SMS but the entire organization.

H_3. H_{3A} hypothesized that the relationship between safety culture perceptions and leadership performance in the human resources frame would be positive and significant, and this hypothesis was supported in the context of the SEM and the data analyzed. The essence of leadership performance in the human resources frame is the leader taking care of his or her people like a family and empowering them to perform (Bolman & Deal, 2013). Zohar (2010) maintained that a leader's concern for his or her people's welfare made the leader more effective and strengthened the safety climate of the organization. Here again it would seem that study results align with the literature, and leadership performance in the human resources frame – a leader caring about his people – directly affects the safety culture of the organization. The regression weight of this frame on safety culture was nearly as high as that of the structural frame on safety culture, a .5-unit increase in safety culture perceptions for every one-unit change in leadership

performance in the human resources frame with a higher level of statistical significance than that of the structural frame. Lipman (2012) echoed a quote that is the essence of leadership as it is taught in the military: “take care of your people and they’ll take care of you” (para 1). Where the effect of taking care of one’s people in an aviation environment is concerned, the results of this hypothesis test seem to confirm that strong leadership in the human resources frame does indeed affect the manner in which employees perceive the safety culture and in so doing affects the way in which they contribute to the health of the organization, per Wiegmann et al.’s (2002) definition of safety culture.

H4. H_{4A} hypothesized that the relationship between safety culture perceptions and leadership performance in the political frame would be positive and significant. Statistically, the relationship was not significant although the regression weight was positive. Bolman & Deal (2013) maintained that leadership in the political frame is about competition, power, and agendas. Schein (2010) argued that one of the ways leaders embed culture in their organizations is through the allocation of both resources and power. Kotter (1996) spoke to the importance of leaders managing the politics within their organizations to facilitate cultural change. While discussions on the importance of the political element of leadership are somewhat common in literature that deals with leadership alone, those same discussions are more difficult to find in literature that focuses on safety culture. Stolzer et al. (2008) alluded to the political element of leadership when they described the importance of the political role of the SMS champion within an organization as the role of that position is politically enabled by the CEO or accountable executive. Perhaps the most direct discussion of the influence of political leadership on safety culture came from Antonsen (2009) who discussed the role of power,

specifically political power, in organizational safety culture. He went as far as to argue that issues of culture and power are so intertwined that safety culture research should incorporate perspectives of power and conflict (Antonsen, 2009). Here, Antonsen's (2009) findings echo those of Schein (2010), and it would therefore seem illogical to argue that politics and power do not play an important role in the creation and maintenance of safety culture.

The results of the current study, however, stand in contrast to Antonsen's (2009) conclusion and indicate that political aspect of leadership is not significant. Yet in the context of the SEM model, the political frame of leadership was not assessed singly but alongside the structural, human resources and symbolic frames, both of which demonstrated significance. A more correct interpretation of the results is not that the political aspect of leadership is not significant, but instead that alongside of the influence of structural and human resources interactions, a leader's influence in the political frame does not have the same *level* of significance. Given the literature's emphasis on the structural elements of leadership and the human resources elements but few discussions on the political elements, this conclusion echoes the findings of others.

H_5. H_{5A} hypothesized that the relationship between safety culture perceptions and leadership performance in the symbolic frame would be positive and significant. Here, the results were somewhat surprising. For while the relationship was not significant, the regression weight was negative. Bolman and Deal (2013) argued that the symbolic frame is where cultural elements of an organization reside, but their depiction of these elements, per the label of the frame, are limited to rituals, symbols, images, and the inspiration that these elements create in subordinates. The questions in their instrument dealing with the

symbolic frame reflect their conclusions. While Schein (2010) also discusses the importance of rituals, symbols, and images, he maintains that culture is really about the way things are done in an organization. Torres (2011) maintains that the credibility of the commander directly affects the command climate or safety culture of an organization, so it would appear that the symbols, or perhaps more pointedly, the trappings of leadership and culture can perhaps have a negative effect on safety culture perceptions. And, as the literature previously reviewed emphasizes, from a safety culture perspective, leaders must lead by example through the actions they take, not the words they speak or even the symbols they may create.

Once again though, it may be that in the context of the SEM and the data analyzed, that alongside the effects of both leadership in the structural frame and leadership in the human resources frame, the effects of leadership in the symbolic frame, like the effects of leadership in the political frame, are pushed into insignificance. It is also possible that the questions that assessed leadership in the symbolic frame may need to be reexamined and perhaps modified to better assess the symbolic elements of both organizational and safety culture.

Overall Conclusions. The results of this study clearly indicate that a program, even one as well designed and intentioned as IS-BAO, cannot create or maintain a safety culture in an organization without the facilitation and direction of the organization's leadership, particularly as leadership is exercised in the structural and human resources frames.

Leaders must direct the creation of policies and guidance at the organizational level to facilitate the implementation and sustainment of the safety culture that allows IS-BAO's SMS to be effective. Leaders must also take care of their people and allow the organization to serve its people as the people serve the organization, or more pointedly, allow the SMS to serve the people who work inside of it as the people work inside the SMS. Leaders must be collaborative in the manner in which SMS processes are executed and provide the people who work inside the safety culture the freedom to make inputs to improve the culture. Kotter (1996) argues that while leaders can start the process for cultural change in an organization, the change is not complete until those inside the organization embrace and internalize the change. The importance and interaction of the structural and human resources frames of leadership where safety culture is concerned would seem to parallel Kotter's construct. Leaders must not only provide the structure to facilitate safety culture, but they must also provide an environment where their people can freely act inside the culture through the SMS. In so doing, leaders allow for closure of the loop between their intentions for the safety culture and actions of their subordinates, the combination of which make the culture real for the organization and embed that culture into the organization.

Where the political and symbolic frames of leadership are concerned, the results are inconclusive. While both elements, particularly the political one, are important in the manifestation of leadership and the impact of that leadership on safety culture, it would seem that the effects of leadership in the structural and human resources frame overshadow the effects of leadership in the political and symbolic frames.

Recommendations

This study examined leadership as a construct apart from safety culture and produced an instrument that demonstrated reliability and validity to assess the relationships between safety culture perceptions, IS-BAO progression and leadership performance. While there are several ways in which the spectrum of knowledge on safety culture could benefit from further research related to this study, the results of this study are immediately applicable to the official literature dealing with safety management system implementation and safety culture. Future investigation could further examine leadership's impact on safety culture, the SEM instrument used in this study, and the effects of IS-BAO/SMS and the various leadership frames on safety culture.

Immediate Applicability to Official Literature. Official regulatory publications on safety management system description and implementation, such as ICAO's Safety Management Manual, the FAA's AC120-92A and IBAC's IS-BAO description, briefly discuss the importance of senior management involvement in the creation, health and maintenance of an SMS. Yet, none of these documents provides a detailed description of how organizational leadership affects the safety culture from either a theoretical or practical perspective. Moreover, the documents do not discuss the impact of specific leadership behaviors on safety culture. For organizations that are new to SMS and safety culture and those organizations with an SMS that are attempting to improve their safety culture, discussions dealing with the importance of leadership and leadership behaviors could provide helpful insight into leadership's critical role in safety

culture creation and maintenance and perhaps challenge leaders to act in a way that better supports the safety culture in their organizations.

Future Studies of Safety Culture and Safety Management Systems. As the literature review in this study has demonstrated, there is much agreement in scholarly literature on the importance of leadership's role in the creation and maintenance of a healthy safety culture. There are also several studies of both safety culture and safety management systems that discuss how the two interact. While leadership has been studied in some safety culture measurement studies, the leadership elements measured were only those that were manifested through the safety culture. The current study was different in that the construct it used examined leadership as a separate element, in and of itself, and then examined the effects of leadership performance on safety culture perceptions. Future studies that focus on safety culture should also examine leadership as a separate element to further investigate the effects of leadership and leadership styles on safety culture and SMS implementation. These studies could explore the use of other leadership assessment instruments that evaluate leadership's impact on the organization and then compare the impact on safety culture perceptions. If smaller populations and organizations were studied, perhaps more detailed leadership instruments like those of The Leadership Circle could be utilized which could provide more in depth analyses of the impact of leadership behaviors on safety culture perceptions.

Further Refinement of the Instrument and Model. Since the first order construct models for leadership performance and safety culture perceptions did not provide sufficient evidence of discriminant validity, a second order construct was devised that directly linked overall leadership performance as a latent variable, to safety culture perceptions. After it was confirmed that correlation between overall leadership performance and safety culture perceptions was less than the standardized regression weights on the two constructs, the second-order model was not further investigated. Future research could focus upon a model that incorporated IS-BAO or SMS progression constructs into the second order construct to determine if that model fit the dataset better than the SEM tested in this study. The current data or a future dataset could be evaluated through the second order model and the appropriate hypotheses re-tested.

Further Research on the Effects of Leadership Performance in the Political and Symbolic Frames. The effects of leadership performance in the political and symbolic leadership frames in this study did not yield results that were significant, but those results may have been overshadowed by the effects of leadership performance in the structural and human resources frames. The literature confirms the importance of the political frame of leadership in general, and there is some discussion about the effects of politics and power on safety culture. Perhaps a version of the SEM that isolates and focuses on both the political and symbolic frames of leadership might provide a better examination of the impact of those frames on safety culture perceptions.

Further Research on IS-BAO-registered Operators. As useful and contributive to the body of knowledge this study may have been, the results were somewhat limited by the lack of participation among the population of the operators who were IS-BAO-registered. Since the results of this study will be published on IBAC's website and shared with the entire IS-BAO community, perhaps the dissemination of the results will lead to more acceptance of this type of research by IS-BAO operators and lessen the resistance to future data-gathering efforts. More attempts should be made to gather additional data from inside the population of IS-BAO-registered operators, using the same instrument to increase the sample size and confirm the conclusions herein. Also, Sonnie Bates, the Director of IS-BAO for IBAC, has mentioned administering the instrument to all IS-BAO-registrants when those registrants are audited for IS-BAO renewal (personal communication, November 18, 2015), perhaps providing a mechanism to increase the sample size without the perceived intrusiveness of mass-survey distribution. Another mechanism for exploration could be an IBAC-provided abbreviated questionnaire, based on the current instrument that would be administered to flight crew members and maintenance personnel by IS-BAO auditors after observation of operational flights or maintenance activities.

Further Research on All Business Aviation Operators. The relationship between safety culture perceptions and leadership does not apply only to IS-BAO registered operators. With support from the NBAA, a sampling frame comprised of IS-BAO and non-IS-BAO operators that are NBAA members could be constructed and a modified version of the study instrument administered to operators selected. The

conclusions obtained from such a study could compare and contrast both the leadership performance and safety culture perceptions of IS-BAO and non-IS-BAO operators.

Final Remarks

Business aviation is not a field that has historically attracted much scientific or scholarly research, as demonstrated by the lack of literature surveyed that dealt with the industry. This lack of scientific study has resulted in a corresponding lack of data where many important subject areas are concerned leaving these areas subject to discussion based on opinions and speculation. While the results of this study may be unsurprising to some, they add empirical data in a vital topic area to an industry that needs it. The results of this study confirm that safety culture in business aviation, as in commercial airline aviation or even non-aviation industries, is about leadership, not a program. While there is much more research that can be performed, perhaps now, given these results, the discussion about safety culture and leadership in the business aviation industry can transition from the realm of opinion and speculation to the realm of data and in so doing, perhaps contribute to raising the level of safety in the industry even higher.

REFERENCES

Adamshick, M. H. (2007). *Leadership and safety climate in high-risk military organizations* (Doctoral Dissertation). Retrieved from ProQuest Dissertations & Theses Global. (304853228).

Adjekum, D. K. (2014). Safety culture perceptions in a collegiate aviation program: A systematic assessment. *Journal of Aviation Technology and Engineering, 3*(2), 44-56. doi:10.7771/2159-6670.1086

Antonsen, S. (2009). Safety culture and the issue of power. *Safety Science,* 47(2), 183-191. Retrieved from:http://dx.doi.org.ezproxy.libproxy.db.erau.edu/10.1016/j.ssci.2008.02.004

Bolman, L. G. (2010). *Research using or influenced by Bolman and Deal's four frames.* Retrieved from http://www.leebolman.com/four_frame_research.htm

Bolman, L. G., & Deal, T. E. (2013). *Reframing organizations*. San Francisco, CA: Jossey-Bass.

Broyhill, C. M. (2014). Refreshing metrics. *Aerosafety World, 9*(7), 27-31.

Byrne, B. (2010). *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. Ontario, Canada: Routledge Academic.

Cooper, D. (2015). Effective safety leadership: Understanding types & styles that improve safety performance. *Professional Safety, 60*(2), 49-53.

Cortés, A., & Rogers, R. (2013, February 15). Empowered Accountability. *Safety Standdown*. Retrieved from http://www.safetystanddown.com/empowered-accountability-is-an-expectation-to-detect-and-act/

Denison. (2015). Denison consulting. Retrieved from http://www.denisonconsulting.com/

Denison, D., Nieminen, L., & Kotrba, L. (2014). Diagnosing organizational cultures: A conceptual and empirical review of culture effectiveness surveys. *European Journal of Work and Organizational Psychology, 23*(1), 145-161. doi:10.1080/1359432X.2012.713173

Díaz-Cabrera, D., Hernandez-Fernaud, E., & Isla-Díaz, R. (2007). An evaluation of a new instrument to measure organisational safety culture values and practices. *Accident Analysis and Prevention, 39,* 1202-1211.

Economy, P. (2015). The 9 traits that define great leadership. Retrieved from http://www.inc.com/peter-economy/the-9-traits-that-define-great-leadership.html

Eisenhower, D. D. (1960). *Public papers of the presidents of the United States: Dwight D. Eisenhower, 1954*. Washington, D.C.: Library of Congress.

Exelon Corporation. (2012). *Exelon nuclear management model.* Kennett Square, PA: Exelon Nuclear Partners.

FAA. (2010). *Safety management systems for aviation service providers.* (Advisory Circular 120-92A). Washington, D.C.: FAA.

FAA. (2014). *FAA aerospace forecast tables: Fiscal years 2014-2034.* Washington, D.C.: U.S. Department of Transportation.

Field, A. (2013). *Discovering statistics using SPSS* (4th ed.). Thousand Oaks, CA: Sage Publications.

Flannery, J. A. (2001). *Safety culture and its measurement in aviation.* Retrieved from: http://www.asasi.org/papers/other/safety_culture_measurement_aviation.pdf

Foisy, S. P. (2008). *A comparative analysis of naval aviation and Air Force squadron commanders' transactional and transformational leadership characteristics* (Doctoral Dissertation). Available from ProQuest Dissertations & Theses Global. (304818321).

Freiwald, D., Lenz-Anderson, C., & Baker, E. (2013). Assessing safety culture within a flight training organization. *Journal of Aviation/Aerospace Education & Research, 22*(2), 41-57.

Freiwald, D. R. (2013). *The effects of ethical leadership and organizational safety culture on safety outcomes* (Doctoral Dissertation). Available from ProQuest Dissertations & Theses Global. (1468941665).

Garson, G. D. (2015). *Structural equation modeling.* Asheboro, NC: Statistical Association Publishing.

Gibbons, A. M., von Thaden, T. L., & Wiegmann, D. A. (2006). Development and initial validation of a survey for assessing safety culture within commercial flight operations. *The International Journal of Aviation Psychology, 16*(2), 215-238.

Giberson, T. R., Dickson, M. W., Randall, K. R., Resick, C. J., Mitchelson, J. K., & Clark, M. A. (2009). Leadership and organizational culture: Linking CEO characteristics to cultural values. *Journal of Business and Psychology, 24*(2), 123-137. doi:10.1007/s10869-009-9109-1

Grote, G. (2012). Safety management in different high-risk domains – all the same? *Safety Science, 50*(10), 1983-1992.

Groves, R. M., Fowler, J., F.J., Couper, M. J., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2009). *Survey methodology*. Hoboken, NJ: John Wiley & Sons, Inc.

Guldenmund, F. W. (2000). The nature of safety culture: A review of theory and research. *Safety Science, 34*(1–3), 215-257.

Guldenmund, F. W. (2007). The use of questionnaires in safety culture research – an evaluation. *Safety Science, 45*(6), 723-743.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis*. Upper Saddle River, NJ: Pearson Education Inc.

Helmrich, B. (2015, January 23). 33 ways to define leadership. *Business News Daily*. Retrieved from http://www.businessnewsdaily.com/3647-leadership-definition.html

IBAC. (2015a). *IS-BAO newsletter 1st QTR 2015*. Montreal, Quebec, Canada: International Business Aviation Council.

IBAC. (2015b). *IS-BAO: An international standard for business aircraft operations*. Montreal, Quebec, Canada: International Business Aviation Council.

IBAC. (2015c). *SMS tools for business aircraft operators*. Montreal, Quebec, Canada: International Business Aviation Council.

ICAO. (2013). *Safety management manual.* (No. Doc 9859). Montreal, Canada: International Civil Aviation Organization.

Kelly, T. K., & Earley, C. E. (2009). Leadership and organizational culture: Lessons learned from Arthur Andersen. *Accounting and Public Interest, 9,* 129-147.

Kelly, T. K., Meyer, R. C., & Patankar. M. (2012). *Safety culture: Testing the safety culture pyramid with structural equation modeling.* (No. Grant # 08-G-014). St Louis, MO: Center for Aviation Safety Research.

Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New York, NY: Guilford Press.

Kotter, J. P. (1996). *Leading change*. Boston, MA: Harvard Business School Press.

Krear-Klostermeier, K. M. (2012). *Analyzing leadership styles of federal aviation administration (FAA) air traffic control managers* (Doctoral Dissertation). Available from ProQuest Dissertations & Theses Global. (1024140300).

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30,* 607-610.

Larson, G. C. (2010, October 1). The dubious dawning of SMS. *Business and Commercial Aviation,* p. 78.

Lin, Y. H. (2012). Modeling the important organizational factors of safety management system performance. *Journal of Modeling in Management, 7*(2), 166-179.

Lipman, V. (2012, September 8). Take care of your people and they'll take care of you. *Forbes.* Retrieved from http://www.forbes.com/sites/victorlipman/2012/09/08/take-care-of-your-people-and-theyll-take-care-of-you/#67630e9566a4

Lumpé, M. (2006). *Leadership and organisation in the aviation industry: Leadership and organisation as a function of the different prevailing professional cultures* (Doctoral Dissertation). Available from ProQuest Dissertations & Theses Global. (301641500).

McCune, D., Lewis, C., & Arendt, D. (2011). Safety culture in your safety management system. In A. J. Stolzer, C. D. Halford, & J. J. Goglia (Eds.), *Implementing safety management systems in aviation* (pp. 135-160). Burlington, VT: Ashgate Publishing Company.

McNeely, S. C. (2012). *Examining the relationship between organizational safety culture and safety management system implementation in aviation* (Doctoral Dissertation). Available from ProQuest, UMI Dissertations Publishing. (1002445201).

NBAA. (2014). *2014 NBAA business aviation factbook.* Washington, DC: National Business Aviation Association.

NTSB. (1992). *Aircraft accident report, Britt Airways, Inc., d/b/a Continental Express flight 2574, in-flight structural breakup, EMB-120RT, N33701, Eagle Lake, Texas, September 11, 1991.* (No. PB92-91 0405 NTSB/ AAR-92/04). Washington, DC: National Transportation Safety Board.

Parry, A. E., & Horton, M. J. (1998). Finding, not looking for leadership: A case study using the Bolman and Deal model. *The Journal of Leadership Studies, 5*(4), 122.

Pater, R. (2012). Cultural leadership: Raising the level: Part 1. *Professional Safety, 57*(3), 28-30.

Penwarden, R. (2013). How to avoid nonresponse error. Retrieved from http://fluidsurveys.com/university/how-to-avoid-nonresponse-error/

Phillips, R. (2012). *Perceived leadership styles and effectiveness of aviation program leaders: A four-frame analysis* (Doctoral Dissertation). Available from ProQuest Dissertations & Theses Global. (1020617160).

Phillips, R. S., & Baron, M. A. (2013). Leadership effectiveness of collegiate aviation program leaders: A four-frame analysis. *Collegiate Aviation Review, 31*(1), 107-127.

Reason, J. (1998). Achieving a safe culture: Theory and practice. *Work & Stress, 12*(3), 293-306.

Remawi, H., Bates, P., & Dix, I. (2011). The relationship between the implementation of a safety management system and the attitudes of employees towards unsafe acts in aviation. *Safety Science, 49*(5), 625-632.

Rietsema, K. W., & Watkins, D. V. (2012). Beyond leadership. *International Journal of Business and Social Science, 3*(4), 22-30.

Sasnett, B., & Ross, T. (2007). Leadership frames and perceptions of effectiveness among health information management program directors. *Perspectives in health information management / AHIMA, American Health Information Management Association, 4*, 8.

Schein, E. H. (2010). *Organizational culture and leadership*. San Francisco, CA: John Wiley & Sons.

Scott, D. K. (1999). A multiframe perspective of leadership and organizational climate in intercollegiate athletics. *Journal of Sport Management, 13*(4), 298-316.

Sharma, S., Mukherjee, S., Kumar, A., & Dillon, W.R. (2005). A simulation study to investigate the use of cutoff values for assessing model fit in covariance structure models. *Journal of Business Research, 58*, 935-943.

Smith, P. M. (1986). *Taking charge*. Washington, DC: National Defense University Press.

Smith, S. D. (2005). Safety management systems - new wine, old skins. *Proceedings of the Reliability and Maintainability Symposium, 2005*, 596-599. doi:10.1109/ RAMS.2005.1408428

Soper, D. (2015). A-priori sample size calculator for structural equation models. Retrieved from http://www.danielsoper.com/statcalc3/calc.aspx?id=89

Stolzer, A. J., Halford, C. D., & Goglia, J. J. (2008). *Safety management systems in aviation* (Kindle ed.). Burlington, Vermont: Ashgate.

Sypawka, W. (2008). *A study of division deans' in the North Carolina community college system self perceived leadership style based on Bolman and Deal's four frame theory* (Doctoral Dissertation). Available from ProQuest Dissertations & Theses Global. (304380763).

TLC. (2015a). Leadership culture survey. Retrieved from https://leadershipcircle.com/assessment-tools/survey/

TLC. (2015b). *Leadership culture survey questions*. Salt Lake City, UT: TLC.

Torres, R. H. (2011). Embracing a safety culture in Coast Guard aviation. In A. J. Stolzer, C. D. Halford, & J. J. Goglia (Eds.), *Implementing safety management systems in aviation* (pp. 109-134). Burlington, VT: Ashgate Publishing Company.

Transport Canada. (2008). *Score your safety culture.* (No. TP13844). Ottawa, ON, Canada: Transport Canada.

USAF. (2012). Air force combined mishap reduction system (CMRS). Retrieved from https://www.afcmrs.org/

Vogt, W. P., Gardner, D. C., & Haeffele, L. M. (2012). *When to use what research design*. New York, NY: The Guilford Press.

von Thaden, T. L., & Gibbons, A. M. (2008). *The safety culture indicator scale measurement system (SCISMS).* (No. HFD-08-03/FAA-08-2). Atlantic City, NJ: FAA.

von Thaden, T. L., Kessel, J., & Ruengvisesh, D. (2008). Measuring indicators of safety culture in a major European airline’s flight operations department. *The Proceedings*

of the 8th International Symposium of the Australian Aviation Psychology Association, Sydney, Australia. 1-8.

Westland, J. C. (2010). Lower bounds on sample size in structured equation modeling. *Electronic Commerce Research and Applications, 9*(6), 476-487. doi:10.1016/ j.elerap.2012.06.001

Wiegmann, D. A., Zhang, H., von Thaden, T. L., Sharma, G., & Gibbons, A. M. (2004). Safety culture: An integrative review. *The International Journal of Aviation Psychology, 14*(2), 117-134. doi:10.1207/s15327108ijap1402_1

Wiegmann, D. A., Zhang, H., von Thaden, T., Sharma, G., & Mitchell, A. (2002). *Safety culture: A review.* (Technical Report No. ARL-02-3/FAA-02-2). Atlantic City, NJ: FAA.

Wolf, H. (2012). The emerging role of safety management systems in aerospace. *Aerospace Conference, 2012 IEEE,* Big Sky, MT. 1-11. doi:10.1109/AERO .2012.6187419

Woo, G. S. (2015). Starting a safety management system culture in small flight school organizations. *Journal of Aviation/Aerospace Education & Research, 24*(3), 1-32.

Zohar, D. (2010). Thirty years of safety climate research: Reflections and future directions. *Accident Analysis and Prevention, 42,* 1517-1522.

APPENDIX A

Safety Culture Perception and Leadership Performance Survey Instrument

Consent Form

***1. The purpose of this research project is to analyze the impact of IS-BAO implementation and leadership on the perception of safety culture in aviation organizations. This research is being conducted by Chris Broyhill, a PhD candidate at Embry-Riddle Aeronautical University. You have been invited to participate because you are a member of an IS-BAO-registered organization. IBAC supports this research and all results from the research will be provided to IBAC for the betterment of the IS-BAO program.**

Your participation in this research study is voluntary. You may choose not to participate. If you decide to participate in this research survey but change your mind, you may exit at any time.

The survey will take approximately 10 minutes. Your individual responses will not be identified and will be kept confidential and stored anonymously in a password protected electronic format. Group aggregate results will be shared with the leadership of participating IS-BAO-registered organizations.

If you have any questions about the research study, please contact Chris Broyhill at broyhilc@erau.edu. This project has been reviewed according to Embry-Riddle Aeronautical University Institutional Review Board (IRB) procedures for research involving human subjects.

ELECTRONIC CONSENT: Please select your choice below.

Clicking on the "agree" button below indicates that:

• you have read the statements above;
• you voluntarily agree to participate; and
• you are at least 18 years of age.

If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button

☐ Agree

☐ Disagree

Respondent Information

***1. What level position do you hold in your organization?**

- Line employee (e.g. pilot, mechanic, scheduler)
- Middle management (e.g. standards captain, lead mechanic, manager)
- Senior management (e.g. Chief Pilot, Director of Maintenance, Aviation Director)

Safety Culture Questions

***1. My organization ensures all personnel are kept up to date with the latest technical and regulatory information necessary to do our jobs.**

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
○	○	○	○	○

***2. My organization places high priority on training.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***3. The budget seems to be more important than training in my organization.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***4. My organization has clear, written guidance. I am aware of all organizational factors that can affect how I do my job.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***5. it's totally up to me to stay updated on the latest technical and organizational data necessary to my job; I can't rely on my organization to keep me aware of new developments or changes.**

Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***6. Line personnel are seldom asked for input when my organization's procedures are developed or changed.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***7. Line personnel are actively involved in identifying and resolving safety and/or operational concerns in my organization.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***8. Line personnel don't really have the authority to make decisions that affect the safety of normal flight operations.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***9. All personnel in my organization believe they will be supported by leadership when they make decisions (like cancelling a flight) in the interest of safety.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***10. My organization's safety reporting system easy to use and convenient.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***11. All personnel can report safety discrepancies without fear of negative repercussions.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***12. All personnel are willing to report information regarding marginal performance or unsafe actions of other employees.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***13. Personnel in my organization don't report incidents where there is no damage or injury.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***14. Personnel are willing to file reports about unsafe situations, even if the situation was caused by their own actions.**

Strongly Disgree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***15. If a safety issue is raised, it will be communicated to everyone in the organization.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***16. If I report a safety problem, it will be addressed in a timely manner.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***17. My organization's personnel are satisfied with the way the organization deals with safety reports.**

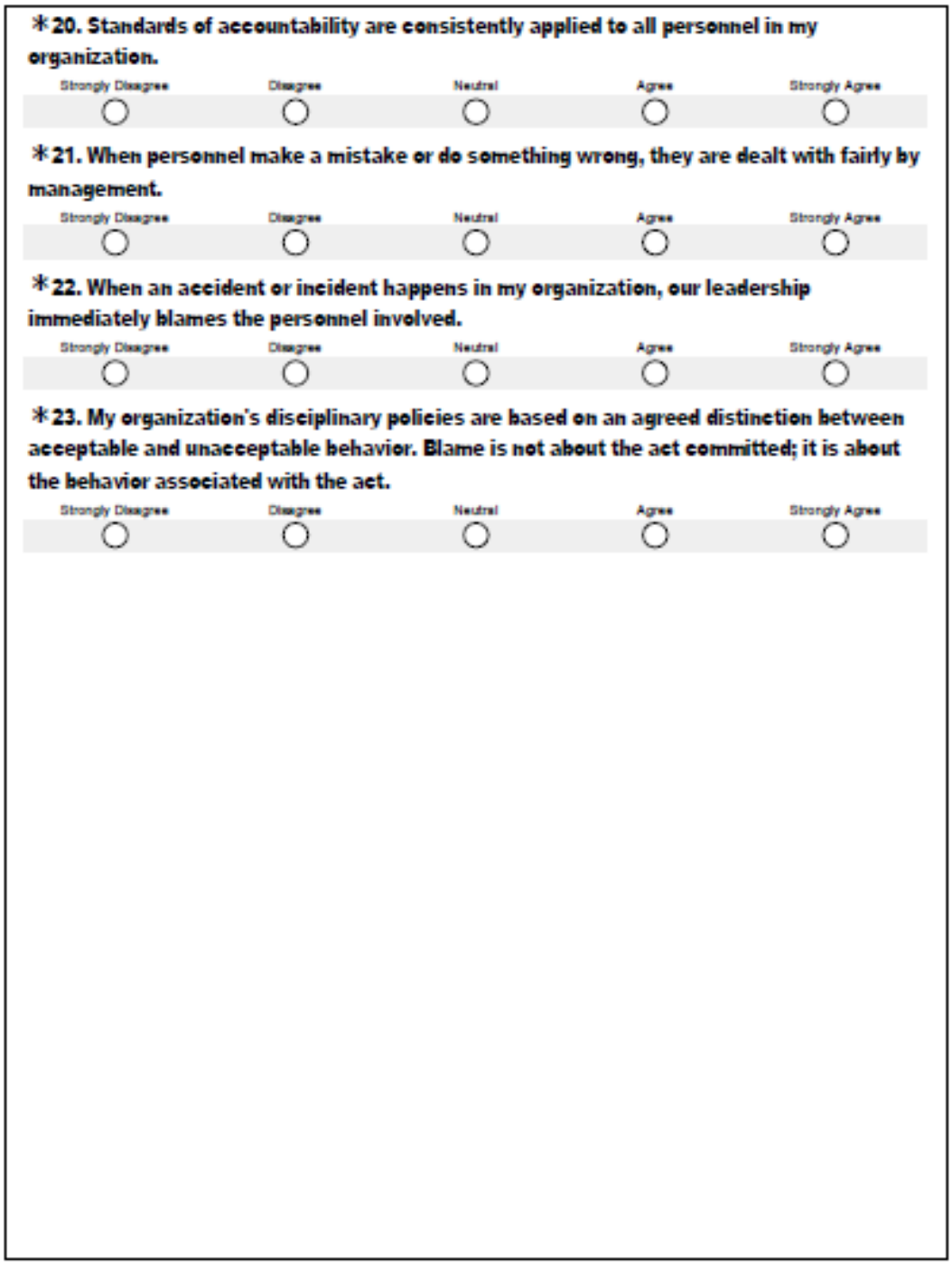
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***18. My organization only keeps track of major safety problems and overlooks minor ones.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

***19. When an error or incident occurs, leadership favoritism towards certain personnel may affect the consequences.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○



*20. Standards of accountability are consistently applied to all personnel in my organization.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

*21. When personnel make a mistake or do something wrong, they are dealt with fairly by management.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

*22. When an accident or incident happens in my organization, our leadership immediately blames the personnel involved.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

*23. My organization's disciplinary policies are based on an agreed distinction between acceptable and unacceptable behavior. Blame is not about the act committed; it is about the behavior associated with the act.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
○	○	○	○	○

Leadership Questions

These questions measure your perception of the leadership in your organization. Think about the person that has the most impact on "the way we do things around here." In most cases that will be the overall flight department manager. If you are the flight department manager, think of your immediate boss.

Each question is a 5 point rating scale and should begin with "My leadership..."

***1. Thinks very clearly and logically.**

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

***2. Shows high levels of support and concern for others.**

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

***3. Shows exceptional ability to mobilize people and resources to get things done.**

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

***4. Inspires others to do their best.**

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

***5. Strongly emphasizes careful planning and clear time lines.**

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

***6. Builds trust through open and collaborative relationships.**

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

***7. Is a very skillful and shrewd negotiator.**

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

***8. Is highly charismatic.**

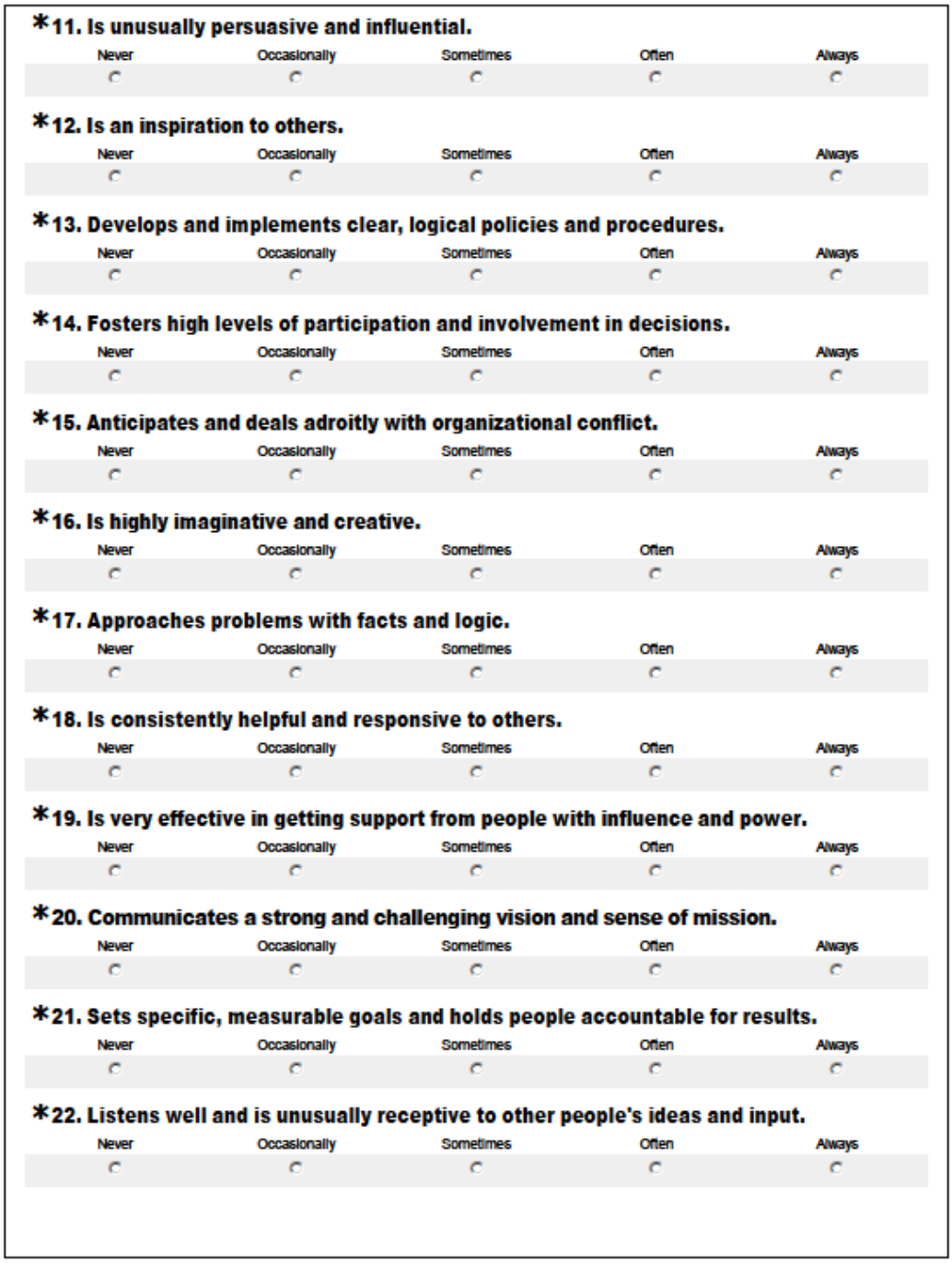
Never	Occasionally	Sometimes	Often	Never
○	○	○	○	○

***9. Approaches problems through logical analysis and careful thinking.**

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

***10. Shows high sensitivity and concern for others' needs and feelings.**

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○



*11. Is unusually persuasive and influential.

Never | Occasionally | Sometimes | Often | Always

*12. Is an inspiration to others.

Never | Occasionally | Sometimes | Often | Always

*13. Develops and implements clear, logical policies and procedures.

Never | Occasionally | Sometimes | Often | Always

*14. Fosters high levels of participation and involvement in decisions.

Never | Occasionally | Sometimes | Often | Always

*15. Anticipates and deals adroitly with organizational conflict.

Never | Occasionally | Sometimes | Often | Always

*16. Is highly imaginative and creative.

Never | Occasionally | Sometimes | Often | Always

*17. Approaches problems with facts and logic.

Never | Occasionally | Sometimes | Often | Always

*18. Is consistently helpful and responsive to others.

Never | Occasionally | Sometimes | Often | Always

*19. Is very effective in getting support from people with influence and power.

Never | Occasionally | Sometimes | Often | Always

*20. Communicates a strong and challenging vision and sense of mission.

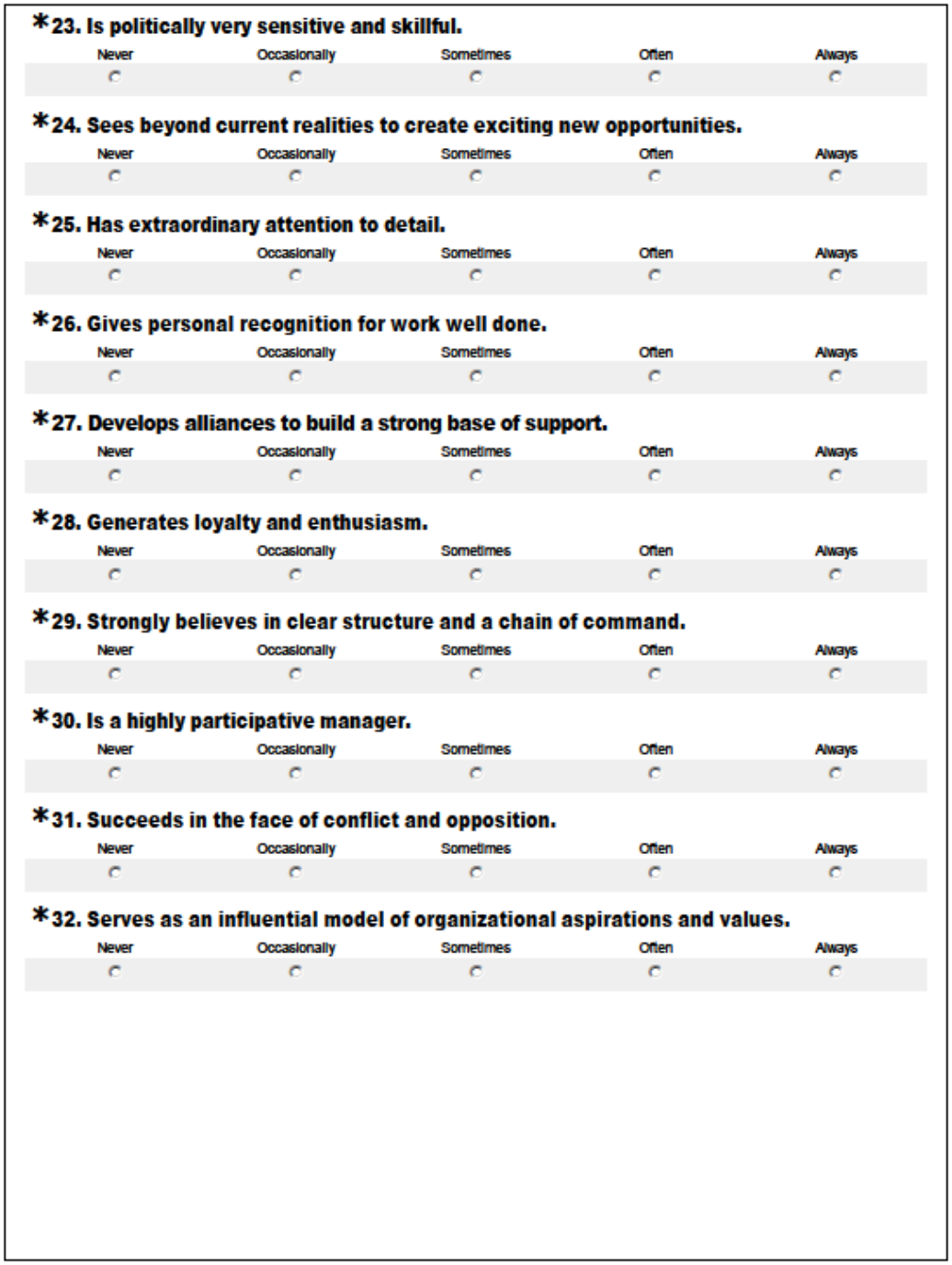
Never | Occasionally | Sometimes | Often | Always

*21. Sets specific, measurable goals and holds people accountable for results.

Never | Occasionally | Sometimes | Often | Always

*22. Listens well and is unusually receptive to other people's ideas and input.

Never | Occasionally | Sometimes | Often | Always



*23. Is politically very sensitive and skillful.

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

*24. Sees beyond current realities to create exciting new opportunities.

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

*25. Has extraordinary attention to detail.

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

*26. Gives personal recognition for work well done.

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

*27. Develops alliances to build a strong base of support.

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

*28. Generates loyalty and enthusiasm.

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

*29. Strongly believes in clear structure and a chain of command.

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

*30. Is a highly participative manager.

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

*31. Succeeds in the face of conflict and opposition.

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

*32. Serves as an influential model of organizational aspirations and values.

Never	Occasionally	Sometimes	Often	Always
○	○	○	○	○

End of Survey

Thank you for your participation. The data you provided will benefit our industry and help to improve the IS-BAO. I really appreciate your time and effort. If you have questions, comments or input, feel free to write me at broyhilc@erau.edu.

Tailwinds!

Chris Broyhill

APPENDIX B

First Pre-test Safety Culture Measurement Instrument with Citations

All questions, with the exception of respondent data, will be answered using a Likert 1-7 scale: *strongly disagree, disagree, slightly disagree, neither agree nor disagree, slightly agree, agree, strongly agree*

Respondent Data
What Stage of IS-BAO Registration has your organization attained?
How many years has your organization been IS-BAO registered?
How many aircraft does your organization operate?
How many people are in your organization?
What level position do you hold in your organization?

*Measurement Area 1 – **The Informed Culture.** People are knowledgeable about the human, technical, organizational and environmental factors that determine the safety of the system as a whole (Stolzer, Halford, & Goglia, 2008).*

1. My organization places high priority on training.
2. Our procedures require all pilots to attend aircraft training twice yearly.
3. My leadership is more concerned with the budget than training.
4. We are required to complete all IS-BAO ancillary training items every 24 months.
5. Leadership makes me aware of all organizational factors that can affect the way I do my job.

*Measurement Area 2 – **The Flexible Culture**. People can adapt organizational processes when facing high temporary operations or certain kinds of danger, shifting from the conventional hierarchical mode to a flatter mode (Stolzer et al., 2008).*

6. My operations manual allows for deviation from established procedures.
7. Line personnel are seldom asked for input when my organization's procedures are developed or changed (Question adapted from Gibbons & von Thaden, 2006).

8. Line personnel are actively involved in identifying and resolving my organization's safety or operational concerns (Question adapted from Gibbons & von Thaden, 2006).
9. Line personnel have little real authority to make decisions that affect the safety of normal flight operations (Question adapted from Gibbons & von Thaden, 2006).
10. If I deviate from my organization's operational procedures, I can expect disciplinary action.

*Measurement Area 3 – **The Reporting Culture**. People are prepared to report their errors and experiences (Stolzer et al., 2008).*

11. The safety reporting system is convenient and easy to use (Question adapted from Gibbons & von Thaden, 2006).
12. All personnel can report safety discrepancies without fear of negative repercussions (Question adapted from Gibbons & von Thaden, 2006).
13. All personnel are willing to report information regarding marginal performance or unsafe actions of other employees (Question adapted from Gibbons & von Thaden, 2006).
14. Personnel don't bother reporting near misses or close calls since these events don't cause any real damage (Question adapted from Gibbons & von Thaden, 2006.)
15. Personnel are willing to file reports about unsafe situations, even if the situation was caused by their own actions (Question adapted from Gibbons & von Thaden, 2006.)

*Measurement Area 4 – **The Learning Culture**. People have the willingness and the competence to draw conclusions from safety information systems and the will to implement major reforms (Stolzer et al., 2008).*

16. If I raise a safety issue it will be communicated to everyone else in my organization (Question adapted from Gibbons & von Thaden, 2006).

17. If I report a safety problem, it will be corrected in a timely manner (Question adapted from Gibbons & von Thaden, 2006).
18. My organization's personnel are satisfied with the way the organization deals with safety reports (Question adapted from Gibbons & von Thaden, 2006).
19. My organization only keeps track of major safety problems and overlooks routine ones (Question adapted from Gibbons & von Thaden, 2006).
20. My organization is willing to change its procedures immediately if a safety concern is identified.

*Measurement Area 5 – **The Just Culture**. People are encouraged, and even rewarded, for providing essential safety-related information. There is a clear line that differentiates between acceptable and unacceptable behavior (Stolzer et al., 2008).*

21. My organization's leadership shows favoritism to certain personnel (Question adapted from Gibbons & von Thaden, 2006).
22. Standards of accountability are consistently applied to all personnel in my organization (Question adapted from Gibbons & von Thaden, 2006).
23. When personnel make a mistake or do something wrong, they are dealt with fairly by management (Question adapted from Gibbons & von Thaden, 2006).
24. When an accident or incident happens, management immediately blames the personnel involved. (Question adapted from Gibbons & von Thaden, 2006).
25. Disciplinary policies are based on an agreed distinction between acceptable and unacceptable behavior. The key determinant of blameworthiness is not so much the act itself—error or violation—as the nature of the behavior in which it was embedded. (Question adapted from Reason, Transport Canada, 2011).

*Measurement Area 6 – **Leadership**. The dynamic processes of culture creation and management are the essence of leadership… leadership and culture are two sides of the same coin (Schein, 2010).*

26. Leadership acknowledges the nature of the organization's activities as high-risk and high-consequence (Question adapted from Stolzer et al., 2008).
27. Safety is a core value in my organization (Question adapted from Gibbons & von Thaden, 2006).
28. Leadership creates a climate of trust throughout the organization and all personnel believe they will be supported by the organization when they make decisions in the interest of safety (Question adapted from Stolzer et al., 2008).
29. Leadership encourages the organization to actively seek hazards and safety risks and when those hazards are identified, prompt action is taken to investigate and mitigate them as practicable (Question adapted from Stolzer et al., 2008).
30. Leadership doesn't show much concern for safety until there is an accident, incident or anomaly which spotlights safety procedures (Question adapted from Gibbons & von Thaden, 2006).

APPENDIX C

Second Pre-test Revised Safety Culture Measurement Instrument

Consent Form

***1. The purpose of this research project is to analyze the correlation of IS-BAO implementation and the perception of safety culture in aviation organizations. The role of leadership in the perception of safety culture will also be analyzed. This research is being conducted by Chris Broyhill, a PhD student at Embry-Riddle Aeronautical University. You have been invited to participate because you are a member of an IS-BAO-registered organization.**

Your participation in this research study is voluntary. You may choose not to participate. If you decide to participate in this research survey, you still may exit at any time.

The survey will take approximately 10 minutes. Your responses will be kept confidential and stored anonymously in a password protected electronic format. The results of this study will be used for scholarly purposes only and will be shared with Embry-Riddle faculty. Group aggregate results will be shared with the leadership of participating IS-BAO-registered organizations.

If you have any questions about the research study, please contact Chris Broyhill at broyhilc@erau.edu. This project has been reviewed according to Embry-Riddle Aeronautical University Institutional Review Board (IRB) procedures for research involving human subjects.

ELECTRONIC CONSENT: Please select your choice below.

Clicking on the "agree" button below indicates that:

- **you have read the statements above;**
- **you voluntarily agree to participate; and**
- **you are at least 18 years of age.**

If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button

☐ Agree

☐ Disagree

Respondent Information

***1. What Stage of IS-BAO Registration has your organization attained?**

- 1
- 2
- 3

***2. How many years has your organization been IS-BAO registered?**

- Less than 1
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- Over 10

***3. How many aircraft does your organization operate?**

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- Over 10

***4. How many people are in your organization?**

- 5 or less
- 5-10
- 10-20
- 20-50
- Over 50

***5. What level position do you hold in your organization?**

- Line employee (e.g. pilot, mechanic, scheduler)
- Middle management (e.g. standards captain, lead mechanic, manager)
- Senior management (e.g. Chief Pilot, Director of Maintenance, Aviation Director)

Survey

***1. My organization ensures all personnel are kept up to date with the latest technical and regulatory information necessary to do our jobs.**

Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree
○	○	○	○	○	○	○

***2. My organization places high priority on training.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***3. The budget seems to be more important than training in my organization.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***4. My organization has clear, written guidance. I am aware of all organizational factors that can affect how I do my job.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***5. it's totally up to me to stay updated on the latest technical and organizational data necessary to my job; I can't rely on my organization to keep me aware of new developments or changes.**

Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree
○	○	○	○	○	○	○

***6. My organization has a mechanism to approve deviations from existing guidance if something unexpected happens.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***7. My organization rarely changes or updates its procedures. Leadership seems to think: "We've always done it that way, why change?"**

Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree
○	○	○	○	○	○	○

***8. Deviation from established procedures is not tolerated for any reason in my organization.**

Stongly Disagree	Disagree	Slightly Disagre	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***9. My organization is willing to change its procedures immediately if a safety concern is identified.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***10. Line personnel are seldom asked for input when my organization's procedures are developed or changed.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***11. Line personnel are actively involved in identifying and resolving safety and/or operational concerns in my organization.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***12. Line personnel don't really have the authority to make decisions that affect the safety of normal flight operations.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***13. All personnel in my organization believe they will be supported by leadership when they make decisions (like cancelling a flight) in the interest of safety.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***14. My organization's safety reporting system easy to use and convenient.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***15. All personnel can report safety discrepancies without fear of negative repercussions.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***16. All personnel are willing to report information regarding marginal performance or unsafe actions of other employees.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Stongly Agree
○	○	○	○	○	○	○

***17. Personnel in my organization don't report incidents where there is no damage or injury.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Stongly Agree
○	○	○	○	○	○	○

***18. Personnel are willing to file reports about unsafe situations, even if the situation was caused by their own actions.**

Strongly Disgree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***19. If a safety issue is raised, it will be communicated to everyone in the organization.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***20. If I report a safety problem, it will be addressed in a timely manner.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***21. My organization's personnel are satisfied with the way the organization deals with safety reports.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***22. My organization only keeps track of major safety problems and overlooks minor ones.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***23. When an error or incident occurs, leadership favoritism towards certain personnel may affect the consequences.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***24. Standards of accountability are consistently applied to all personnel in my organization.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***25. When personnel make a mistake or do something wrong, they are dealt with fairly by management.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***26. When an accident or incident happens in my organization, our leadership immediately blames the personnel involved.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***27. My organization's disciplinary policies are based on an agreed distinction between acceptable and unacceptable behavior. Blame is not about the act committed; it is about the behavior associated with the act.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***28. Leadership encourages us to actively identify hazards and safety risks and when we do, they take prompt action to investigate and mitigate them as practicable.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***29. Leadership doesn't show much concern for safety until there is an accident, incident or anomaly which spotlights safety procedures.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***30. Our safety management system is about maintaining appearances or "checking the box." It hasn't made any real difference in safety.**

Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slighty agree	Agree	Strongly agree
○	○	○	○	○	○	○

Survey Assessment

***1. I had no trouble understanding the wording or the intent of the questions in this survey.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***2. The wording of some of the questions influenced how I answered them.**

Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***3. This survey seemed to cover areas sufficient to measure safety culture.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***4. This survey seemed to cover areas sufficient to assess leadership's involvement in safety culture.**

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slight Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

***5. From a time perspective, this survey seemed:**

- ○ Not long enough
- ○ About right
- ○ Just a little too long
- ○ Way too long

APPENDIX D

Bolman and Deal's Leadership Orientation Instrument (Others)

Name of person described:_____

Group code (if any): _____

LEADERSHIP ORIENTATIONS (OTHER)[1]

This questionnaire asks you to describe the person that you are rating in terms of leadership and management style.

I. **Leader Behaviors**

You are asked to indicate *how often* each item is true of the person that you are rating.

Please use the following scale in answering each item.

1	2	3	4	5
Never		Sometimes		Always
	Occasionally		Often	

So, you would answer '1' for an item that is never true of the person you are describing, '2' for one that is occasionally true, '3' for one that is sometimes true, and so on.

Be discriminating! The results will be more helpful to the ratee if you think about each item and distinguish the things that the ratee really does all the time from the things that s/he does seldom or never.

1. _____ *Thinks very clearly and logically.*

2. _____ *Shows high levels of support and concern for others.*

3. _____ *Shows exceptional ability to mobilize people and resources to get things done.*

4. _____ *Inspires others to do their best.*

---

[1]8 1990, Lee G. Bolman and Terrence E. Deal

5. _____ *Strongly emphasizes careful planning and clear time lines.*
6. _____ *Builds trust through open and collaborative relationships.*
7. _____ *Is a very skillful and shrewd negotiator.*
8. _____ *Is highly charismatic.*
9. _____ *Approaches problems through logical analysis and careful thinking.*
10. _____ *Shows high sensitivity and concern for others' needs and feelings.*
11. _____ *Is unusually persuasive and influential.*
12. _____ *Is an inspiration to others.*
13. _____ *Develops and implements clear, logical policies and procedures.*
14. _____ *Fosters high levels of participation and involvement in decisions.*
15. _____ *Anticipates and deals adroitly with organizational conflict.*
16. _____ *Is highly imaginative and creative.*
17. _____ *Approaches problems with facts and logic.*
18. _____ *Is consistently helpful and responsive to others.*
19. _____ *Is very effective in getting support from people with influence and power.*
20. _____ *Communicates a strong and challenging vision and sense of mission.*
21. _____ *Sets specific, measurable goals and holds people accountable for results.*
22. _____ *Listens well and is unusually receptive to other people's ideas and input.*
23. _____ *Is politically very sensitive and skillful.*
24. _____ *Sees beyond current realities to create exciting new opportunities.*
25. _____ *Has extraordinary attention to detail.*
26. _____ *Gives personal recognition for work well done.*
27. _____ *Develops alliances to build a strong base of support.*

28. _____ *Generates loyalty and enthusiasm.*

29. _____ *Strongly believes in clear structure and a chain of command.*

30. _____ *Is a highly participative manager.*

31. _____ *Succeeds in the face of conflict and opposition.*

32. _____ *Serves as an influential model of organizational aspirations and values.*

I. **Leadership Style**

This section asks you to describe the leadership style of the person that you are rating. For each item, give the number "4" to the phrase that best describes this person, "3" to the item that is next best, and on down to "1" for the item that is least like this person.

1. The individual's strongest skills are:

_____ a. *Analytic skills*
_____ b. *Interpersonal skills*
_____ c. *Political skills*
_____ d. *Ability to excite and motivate*

2. The best way to describe this person is:

_____ a. *Technical expert*
_____ b. *Good listener*
_____ c. *Skilled negotiator*
_____ d. *Inspirational leader*

3. What this individual does best is:

_____ a. *Make good decisions*
_____ b. *Coach and develop people*
_____ c. *Build strong alliances and a power base*
_____ d. *Energize and inspire others*

4. What people are most likely to notice about this person is:

_____ a. *Attention to detail*
_____ b. *Concern for people*
_____ c. *Ability to succeed, in the face of conflict and opposition*
_____ d. *Charisma.*

5. This individual's most important leadership trait is:

_____ a. *Clear, logical thinking*
_____ b. *Caring and support for others*
_____ c. *Toughness and aggressiveness*
_____ d. *Imagination and creativity*

6. This person is best described as:

_____ a. *An analyst*
_____ b. *A humanist*
_____ c. *A politician*
_____ d. *A visionary*

III. **Overall rating**

Compared to other individuals that you have known with comparable levels of experience and responsibility, how would you rate this person on:

1. Overall effectiveness as a **manager**.

1	2	3	4	5
Bottom 20%		Middle 20%		Top 20%

2. Overall effectiveness as a **leader**.

1	2	3	4	5
Bottom 20%		Middle 20%		Top 20%

IV. **Background Information**

The following information will not be provided to the ratee, but will contribute to our efforts to understand how perceptions of leadership styles are influenced by the relationship between rater and ratee.

1. Are you: ____Male ____Female

2. Which of the following best describes your work relationship with the ratee:

_____ The ratee is at a higher level in the organization than I am.

_____ The ratee and I are at about the same organizational level.

_____ I am at a higher level in the organization than the ratee.

_____ I am a client or customer of the ratee's organization.

_____ Other. Please specify: _____

Appendix E

Bolman Permission to Use Instrument

Chris Broyhill

From: Bolman, Lee G. <BolmanL@umkc.edu>
Sent: Wednesday, February 18, 2015 9:47 PM
To: Chris Broyhill
Subject: RE: Official Permission to Use Leadership Frames Questionnaire for Dissertation Research - Revised Request

Chris,

I'm pleased to give you permission to use the Leadership Orientations Survey in your study.

Best wishes in your research. I look forward to learning about your results.

Lee G. Bolman, Ph.D.
Professor and Marion Bloch/Missouri Chair in Leadership
Bloch School of Business and Public Administration
University of Missouri-Kansas City
5100 Rockhill Road
Kansas City, MO 64110

Tel: 816-235-5407.

Website: www.leebolman.com

From: Chris Broyhill [mailto:chris.broyhill@gmail.com]
Sent: Wednesday, February 18, 2015 9:49 PM
To: lee@bolman.com
Subject: Official Permission to Use Leadership Frames Questionnaire for Dissertation Research - Revised Request

HI Dr. Bolman,

I wanted to send this from a different email address in the event my previous email got routed to your spam folder. Please review the email below and let me know what you think.

Thanks for your time, sir.

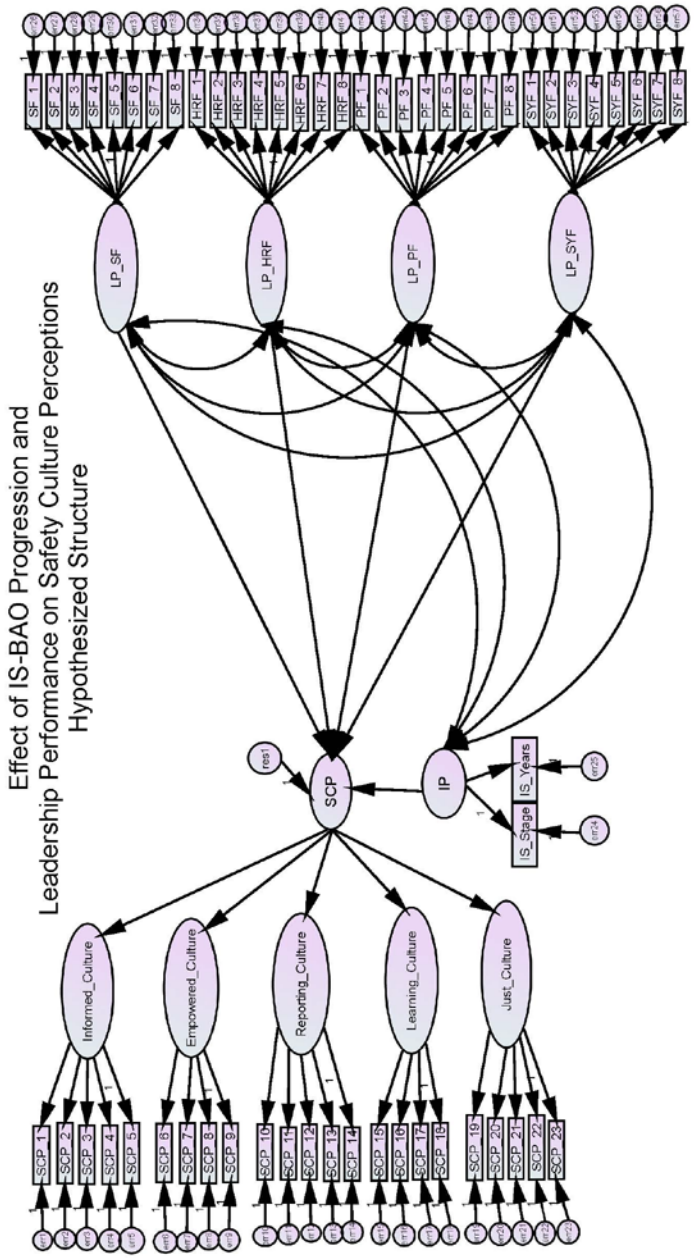
Sincerely,

Chris

Christopher M. Broyhill
721 Stuarts Drive
St. Charles, IL 60174
Mobile Phone: (302)230-6263
EFax: (302)338-8021
Email: chris.broyhill@gmail.com

Appendix F

Hypothesized SEM Model



APPENDIX G

ERAU IRB EXEMPTION

Embry-Riddle Aeronautical University
Application for IRB Approval
Exempt Determination

Principle Investigator: Chris Broyhill **Other Investigators:** Tim Brady **Role:** Student
Campus: World Wide **College:** COA

Project Title: The Effect of IS-BAO Progression and Leadership Performance on Safety Culture in Business Aviation Flight Operations

Submission Date: 8/10/2015 **Determination Date:** 8/10/2015

Review Board Use Only

Initial Reviewer: David Ison/M.B. McLatchey

Exempt: Yes

Approved: 

M.B. McLatchey

World Wide IRB Representative/Chair of the IRB Signature

Brief Description: The International Standard, Business Aircraft Operations (IS-BAO) is a code of business aviation industry best practices that has been adopted by over 700 business aviation operators worldwide. According to many in the industry,IS-BAO and the safety management system (SMS) that is its core element, is the recognized mechanism to develop a healthy safety culture in business aviation operators. But scholarly and regulatory literature contend that leadership is the most important influence on safety culture in high-reliability organizations in and out of the aviation field. This study will compare and contrast the effects of IS-BAO progression and leadership performance on safety culture perceptions in IS-BAO registered business aviation operators. While numerous safety culture studies and assessments have been conducted in and for commercial aviation only a very few studies have focused on business aviation and none have directly measured the effect of IS-BAO on safety culture. Additionally, no studies have been performed which measure the impact of leadership performance on safety culture in business aviation organizations. The currently study will definitely increase knowledge in both these areas

This research falls under the **exempt** category as per 45 CFR 46.101(b) under:

☐(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

☒(2) Research involving **only** the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures (of adults), interview procedures (of adults) or observation of public behavior. Participant information obtained will remain anonymous and confidential.

☐(3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

☐(4) Research involving the collection or study of **existing** data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

☐(5) Research and demonstration projects which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) Public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

☐(6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

An exempt research project does not require ongoing review by the IRB, unless the project is amended in such a way that it no longer meets the exemption criteria.

Appendix H

IBAC Approval for Research

Chris Broyhill

From: cas.isbao@gmail.com on behalf of Sonnie Bates <sbates@ibac.org>
Sent: Friday, May 22, 2015 2:38 AM
To: Christopher Broyhill
Subject: Approval for Research

Chris,

I'm pleased to inform you that IBAC has agreed to support your survey research in the effectiveness of IS-BAO and leadership performance on safety culture in IS-BAO-registered operators in the United States.

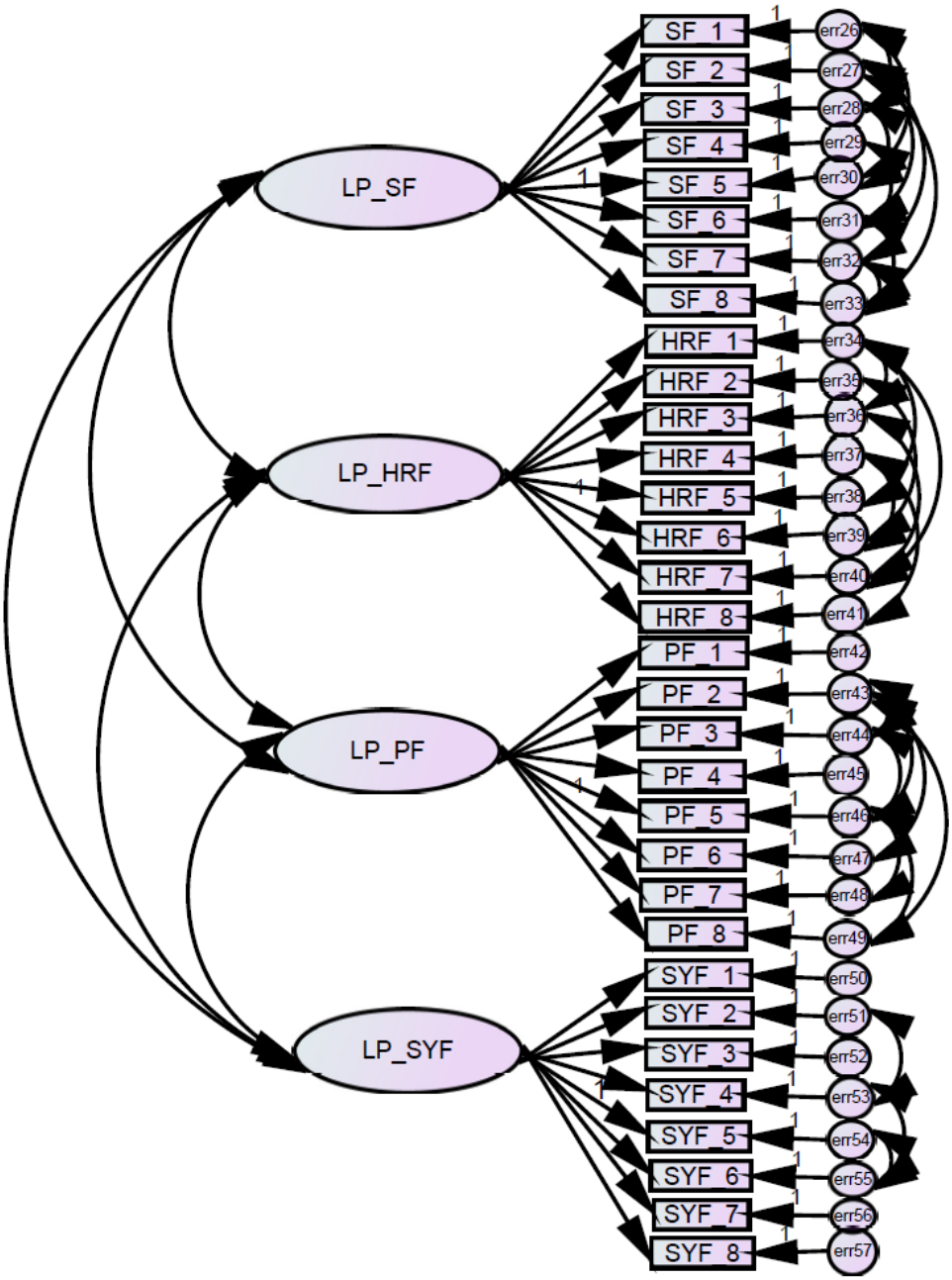
When you're ready to begin data collection, I'll send emails on your behalf to solicit participation from those registrants in our database.

Looking forward to seeing the results of your work!

Sonnie G. Bates, CAM
Director, IS-BAO Program
International Business Aviation Council, Ltd
603-233-7196
IS-BAO Stage 3 Performance Indicators

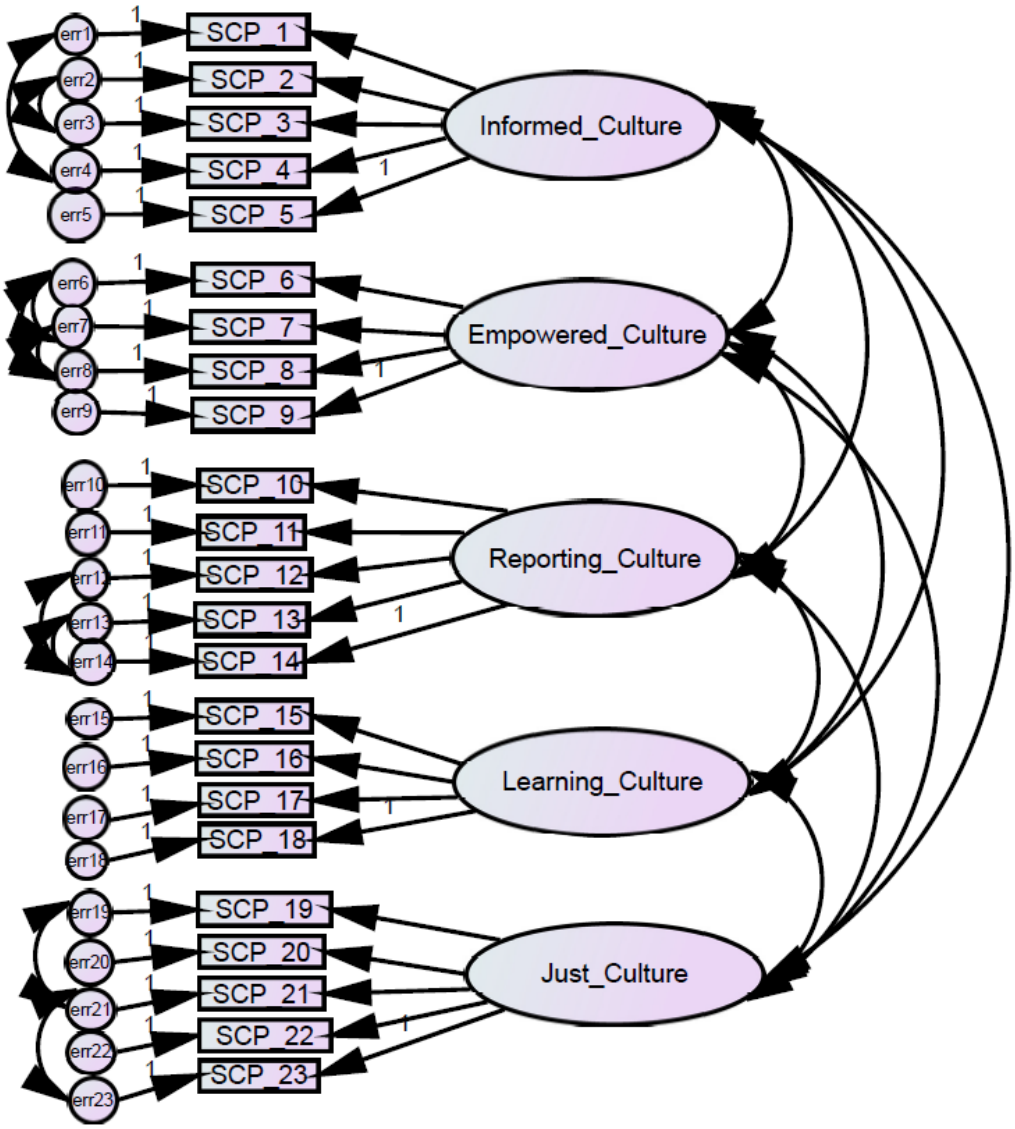
Appendix I

Final Leadership Performance Construct CFA Model



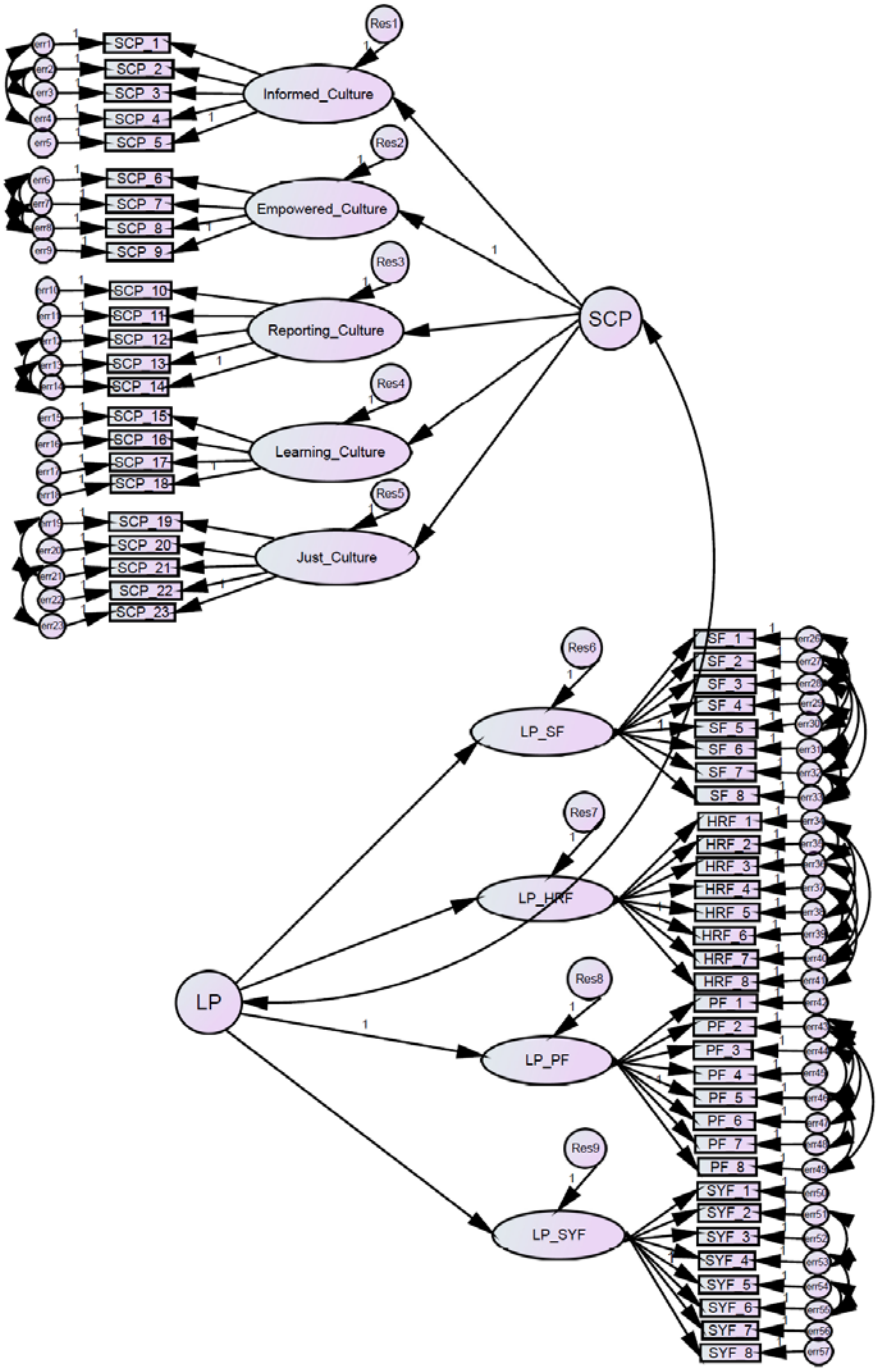
Appendix J

Final Safety Culture Perceptions Construct CFA Model



Appendix K

Second Order Leadership Performance and Safety Culture Perceptions CFA



Appendix L

Final SEM Model