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A cross-sectional and mixed-method assessment of safety culture and safety climate at a regional airline

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A CROSS-SECTIONAL AND MIXED-METHOD ASSESSMENT OF SAFETY CULTURE AND SAFETY CLIMATE AT A REGIONAL AIRLINE

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of

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For my families

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ABSTRACT

Walala, Micah S. Ph.D., Purdue University, May 2016. A Cross-Sectional and Mixed-Method Assessment of Safety Culture and Safety Climate at a Regional Airline. Major Professor: Richard Fanjoy.

The researcher applied a mixed methods approach to conduct a cross-sectional assessment of the safety culture, safety climate, and SMS at a regional airline in the United States. Data collection techniques were comprised of interview, online-survey, and a focus group activity. Participants in the current study were maintenance technicians, flight attendants, dispatchers, pilots, and managers. Results indicated significant differences of perception of safety climate, safety culture, and Safety Management System between the maintenance technicians and flight attendants. The length of time a participant had worked at the subject airline and age of the participant appeared to be significant factors of perception of safety climate. The ASAP safety program appeared to be the most positively perceived safety program across all the studied groups. Participants expressed a general positive outlook of safety at the subject airline. Elements of concern highlighted included routine violation and senior management being out of touch with frontline employees. The researcher presents recommendations for practice and future research.

Keywords: Safety Culture, Safety Management System, Safety climate, Perceptions

CHAPTER 1. INTRODUCTION

The purpose of this study was to assess the safety climate and safety culture at a regional airline in the United States (U.S). Employee perception of the subject airline's safety climate, as well as that of the five elements of a positive safety culture (Reason, 1997) were assessed. Elements of safety climate assessed in the current study are three of the most identified by researchers (Dedobbeleer & Béland, 1991; Flint et al., 2000; Patankar et al., 2012; Seo et al., 2004; Zohar, 2000). Additionally, the employee perception of the four pillars of Safety Management System (SMS) (International Civil Aviation Organization [ICAO], 2013), were evaluated. Participants of the study were front-line employees and management of the subject airlines. The two groups are critical to airline operational safety (Taylor, 2012). The front-line participants were from the groups *Pilots, Flight attendant, Dispatch, and Maintenance.* This study used a mixed-method (Creswell, 2009) approach as well as a cross-sectional design (Wreathall, 1995).

Safety is an integral element of the aviation industry. Like many industries, the aviation industry has inherent risks that need to be regularly identified and managed to improve operational safety. Identifying risk is among the key steps to managing risk. Lack of clarity in the process by which risks are identified and

interpreted can hamper efforts to monitor and improve safety. In addition, a robust safety system is essential to the effective management of safety (Macrae, 2009).The historical method of assessing safety has been primarily through observing and measuring the rate of accidents and/or incidents (Liou et al., 2008). Gerede (2014) considers this approach objective and practical, but also ‘reactive’ (p. 1) as safety is assessed after occurrences of unsafe events. Nevertheless, it is no longer logical to manage safety reactively due to relatively lower rate of accidents (Liou et al., 2008; Wood, 2003). Additionally, the traditional approach to management of safety fails to adequately address other diverse operational safety elements. Liou et al. (2008) identified other aspects of safety as such as human and organizational factors; operators; aviation regulators; aviation service providers; and organizational culture. These factors may contribute to latent unsafe conditions that might be difficult to forecast using historical safety assessment practices (Liou et al., 2008).

The Safety Management System (SMS) is a performance-based and risk-based approach to managing safety. SMS addresses some of the deficiencies inherent in the historical style of evaluating safety performance by taking a top-down approach and robust commitment to safety in an organization (Lewis, 2008). SMS functions on the premise that safety is achieved by cultivating a positive safety culture that runs through all levels of an organization (Chen & Chen, 2011; Gill & Shergill, 2004; Stolzer, Halford, & Goglia, 2008). Culture influences perceptions of safety programs. Actions and behaviors of individuals, organizations, and societies are dictated by the perceptions they have

concerning decisions they have to make (International Aviation Transport Association [IATA], 2011; Lewis, 2008).

Positive safety culture is characterized by elements such as learning, reporting, informed, flexible, and just cultures (International Association of Oil & Gas Producers, 2013; Reason, 1997). Of these, reporting culture is integral to a proactive and predictive safety initiative as it facilitates the availability of data. Data is critical to identify latent failures that can be mitigated to improve safety. Then again, reporting culture is dependent upon a sound just culture. A just culture is one in which trust thrives that encourages members of an organization or community to provide information about safety incidents without fear of unjust persecution. It provides a blame-free atmosphere conducive for genuine dialogue and room to learn from safety related reporting.

Assessing employee perceptions towards an organization's safety practices, policies, and procedures can best reflect an individual's likely intentions and behavior (Gerede, 2014; Taylor, 2012). Intentions and behavior may include safety reporting and adherence to established policies, practice, and procedures. The collective perceptions of components of a safety system can be useful to predict organizational trends in attitudes towards safety. The trends can identify areas of an organization that have a strong safety standing as well as areas that require a stronger emphasis on safety. Evaluation of an organization's safety culture is particularly important in high-reliability organizations such as energy and aviation that have low rates of accidents and incidents (Gerede, 2014).

The effectiveness of SMS has led to the program being mandated in some industries. ICAO requires international carriers and international airports to have SMS in place (Maurino, 2007). Other sectors of aviation, such as domestic airports and general aviation (GA) that include flight training, are also encouraged to implement SMS (May, 2010).

The development and continual reevaluation of SMS policies, procedures, and actions is vital to an effective safety risk management program (Gerede, 2014). Efforts towards establishing a vigorous SMS are partially based on feedback from employees and other relevant stakeholders (Chen & Chen, 2011; Gill & Shergill, 2004). This study addresses research questions by evaluating employee perceptions of the subject organization's safety policies, procedures, and practices.

1.1 Significance

Similar to other high-reliability organizations such as the healthcare and energy sectors, the aviation industry is employing SMS as a predictive and comprehensive approach to managing safety (Stolzer et. al., 2008). The core success variable of a robust safety program is how well the safety program is established and sustained in a positive safety culture (IATA, 2011; Lewis, 2008). Understanding perceptions of safety culture is an important gap-analysis step in an organization's efforts to create and re-evaluate an effective SMS (Stolzer et al. 2008). Liou et al. (2008) underscore the importance front-line employee's role in an organization's safety. This study proposed to provide an in-depth overview of

front-line employee understanding and perceptions of safety policies, procedures, and practices. Organizational culture can be dynamic (Reason, 1998; Stolzer et al. 2008; Taylor, 2012). It is imperative that organizations assess their safety culture regularly as part of their on-going effort to safety strategic planning and management.

This study reflects with ICAO's standard and recommended practices and FAA's guidelines. The two institutions challenge the aviation community to persistently evaluate and cultivate a positive operational safety culture. A dynamic positive safety culture is essential in matching the dynamic nature of the aviation industry in areas such as technology and environment. The guidelines also include the adoption of SMS (ICAO, 2009).

1.2 Statement of Purpose

The purpose of this study was to evaluate safety culture at a regional airline by assessing employee understanding and perceptions of their current organization's safety policies, procedures, and practices. Participants were front-line employees and managers. Front-line employees included *pilots, dispatchers, flight attendants, and maintenance technicians*. In addition, the current research aimed to investigate whether there were any statistically-significant differences in safety culture perceptions across the front-line employee groups and between the front-line employee groups and managers.

This study was conducted in three phases. The first two phases were survey and interview. These phases were intended to identify participants' general

perceptions of the subject airline's safety culture, safety climate, and SMS. The results from the first two phases of the study formed the building block for the third phase, focus groups. The purpose of the focus group was to gain in-depth understanding of common themes and concerns identified by the first two phases of the study.

Understanding of organization safety perception has potential to further improve an organization's safety risk management. Significant differences in organization safety culture perception between the managers and front-line employees may elicit further investigation for purposes of improving safety. Likewise, differences of perceptions across the studied groups of front-line employees may suggest latent variables of safety, whether positive or negative. The variables may be explored further to reinforce safety risk management in the organization. Results from the current study have potential to assist in SMS implementation and reevaluation efforts (Cheng & Cheng, 2011).

1.3 Research Question

The purpose of this research was to evaluate perceptions of safety culture and safety climate at a regional airline by answering the following questions:

1. *What are employee perceptions of the safety climate at the subject airline among and across the target study groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline?*

H_o: Perceptions of the safety climate at the subject airline are positive and seamless across all the studied groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline.

H_a: Significant variations exist regarding safety climate across the studied groups in the subject airline.

2. *What are employee perceptions of the four SMS pillars at the subject airline, among and across the target study groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline?*

   H_o: Perceptions of the four pillars of SMS at the subject airline are positive and seamless across all the studied groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline.

   H_a: Significant variations exist regarding the four pillars of SMS across the studied groups in the subject airline.

3. *What are employee perceptions of the safety culture at the subject airline among and across the target study groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline?*

   H_o: Perceptions of the safety culture at the subject airline are positive and seamless among and across all the studied groups: pilots,

maintenance technicians, dispatchers, flight attendants, and the management of the subject airline

H_a: Significant variations exist regarding safety culture among and across the studied groups in the subject airline

H_a: Significant variations exist regarding safety culture among the studied groups in the subject airline

4. *Are demographic elements such as age, gender, and length of employment, significant variables of perception of safety climate and/or safety culture at the subject airline*?

H_o Demographic elements such as gender and age are not significant variables of safety climate and/or safety culture at the subject airline.

H_a: Demographic elements such as gender and age are significant variables of safety climate and/or safety culture at the subject airline

1.4 Assumptions

The study made the following assumptions:

1. Participants were honest with all their responses.
2. All respondents were employees of the subject airline during the study period.
3. Participants participated without any undue negative influence.
4. All employees had access to the subject airline's Intranet, and to information pertaining to the current study.

5. All employees have access to, and read the subject airline's monthly safety newsletter.
6. All participants made a single complete attempt on the online survey

1.5 Limitations

This study had the following limitations:

1. Two of the three phases of the study, interview and focus group activities, were limited to participants of a single operational location.
2. The survey study was limited by the number of complete responses.
3. Participants of the survey phase of the study may not have been a truly random sample.
4. The current study limited evaluated safety climate perceptions to three

1.6 Delimitations

The delimitations of the study were:

1. The study sample was limited to front-line employees: pilots, maintenance technicians, flight attendants, and dispatchers, as well as managers.
2. The study limited participants to the then-current employees of the subject airline.

1.7 Definition of Key Terms

Accident – “Any unplanned act or event that results in damage to property, material, equipment, cargo, or personal injury or death when not the result of enemy action” (Ericson, 2005, p. 14).

Federal Aviation Administration (FAA) – an agency that regulates civil aviation in United States (Taylor, 2012)

Hazard – “A hazard is a condition that could foreseeably cause or contribute to an accident” (DOT, 2012, p. 8).

High Reliability Organization – are organizations that “operate in hazardous, fast-paced, and complex environments yet avoid catastrophic accidents.” (Tolk, Cantu, & Beruvides, 2015, p. 218).

International Civil Aviation Organization (ICAO) – an agency of the United Nations responsible for standardized development of civil aviation to its member States worldwide, and for promoting aviation safety.

Mishap – “An unplanned event or series of events resulting in death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment” (DOD, 2000, p. 6)

Occurrence – “…is [a] tracking system for call-offs when a pilot or flight attendant misses work” (“deleted” [study subject airline liaison], March 18, 2016)

Risk – “...an expression of the future impact of an undesired event in terms of event *severity* and event *likelihood*” (FAA, n.d., para. 2)

Safety – is "…the state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management" (ICAO, 2013, p. 2-1).

1.8 Summary

This chapter outlined the background of the study and highlighted the study's significance, purpose, and assumptions. The chapter also addressed research questions, limitations, and delimitations of the study. The next chapter discusses the literature related to this study.

CHAPTER 2. LITERATURE REVIEW

This chapter provides an in-depth analysis of aviation safety culture and aviation safety management, and addresses the concept of a safety management system (SMS). In addition, the chapter outlines the role of SMS in aviation safety culture and aviation safety in general. The role of aviation safety perceptions as an indicator of safety behavior and organizational safety status is discussed. The chapter also revisits previously related studies as well as discusses theories and approaches related to safety.

2.1 Safety, Risk, and Hazard

Scholars, as well as the type of discipline or industry have differed regarding the definition of safety. Hudson (2001b) took a conventional understanding of safety as “Thou shall not harm” (p. 8.1). Ericson (2005) views safety as the process of “identification of hazards, assessment of hazard mishap risk, and the control of hazards presenting acceptable risks” (p. 14). ICAO’s (2013) position on safety is “… the state at which the risk of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and risk management” (p. 1-1). This study focused on the ICAO (2013) definition of safety. It recognizes the need to eliminate, minimize, or mitigate hazards and/or associated risks. The

definition also acknowledges that aspects of hazards and risk are dynamic, and so should be the efforts towards managing safety.

The process of risk management starts by establishing a standardized approach of identifying potential hazards. The Department of Transportation (DOT), defines a hazard as "…a condition that could foreseeably cause or contribute to an accident" (DOT, 2012, p. 8). A hazard becomes a risk when it is no longer contained. This study defines risk as "...an expression of the future impact of an undesired event in terms of event *severity* and event *likelihood*" (FAA, n.d., para. 2).

Stolzer, Halford, and Goglia, (2011) referred to the total risk an organization is subjected to as *enterprise risk*. Enterprise risk management (ERM) is composed of risks such as strategic, financial, compliance, and corporate image risks. Others are environmental, project, and operational risk. This study focused on operational risk, a risk associated with elements such as assets, people, and technology. This study will be focusing specifically on human perceptions. To manage safety, the mentioned aspects of safety have to be identified and measured.

2.2 Identification and Measurement of Safety

Vick (2002) described safety as a concept and construct, hence subjective and immeasurable. Subsequently, Rose (2006) suggested ascertaining safety in some form that allows it to be quantified and more accurately measured. Assessing risk provides a building block to quantify and measure safety. Yet, like

safety, risk can be subjective in many variables such as individuals, type of discipline, nature of an organization, and individual experiences (Adjekum, et al., 2015; Taylor, 2012). Risks in high-reliability organizations such as petroleum and nuclear industries may lead to catastrophic results to include loss of life, injury, and destruction of property. On the other hand, risks in non-high-reliability organizations such as commercial and social institutions may often result in minimal injury to life and property. It is therefore imperative that industries and organizations define and standardize their approach to hazard analysis and risk management.

In 2011, Stolzer et al. outlined five steps of a hazard-management process as identifying risk; measuring and assessing of the amount and nature of exposures; reducing the magnitude and length of exposure, transferring or elimination exposure; reporting the identified risk; and accepting risk. However, hazards have to first be perceived or identified. The process of hazard identification addresses considerations such as *who, what, where, when*, and *why* events occurred (Stolzer et al., 2011). These considerations permit for a more exhaustive assessment of hazards and their effects. Risk analysis appraises the likelihood of an event occurring against the severity of the effects of the event (FAA, n.d.). The values, *likelihood* (as depicted in Table 1) and *severity,* (as depicted in Table 2) of the risks under consideration are defined by individual industries and organizations.

Table 1 *Categorization of the Likelihood of Occurrence of a Risk*

	Likelihood Scale Definitions	
Frequent	Individual	Likely to occur often
	Fleet	Continuously experienced
Probable	Individual	Will occur several times
	Fleet	Will occur often
Occasional	Individual	Likely to occur some time.
	Fleet	Will occur several times
Remote	Individual	Unlikely to occur, but possible
	Fleet	Unlikely to occur but can be reasonably expected to occur
Improbable	Individual	So unlikely, it can be assumed it will not occur
	Fleet	Unlikely to occur, but possible

Note. Adopted from "System safety processes," by FAA, n.d., Retrieved from https://www.faasafety.gov/gslac/alc/libview_normal.aspx?id=6877

Table 2 *Categorization of Severity Scale*

Severity Scale Definitions	
Catastrophic	Results in fatalities and/or loss of the system
Critical	Severe injury and/or major system damage
Marginal	Minor injury and/or minor system damage
Negligible	Less than minor injury and/or less than minor system damage

Note. Adopted from "System safety processes," by FAA, n.d., Retrieved from https://www.faasafety.gov/gslac/alc/libview_normal.aspx?id=6877

A desirable safety status is one with the lowest probability of occurrence of risk and the lowest severity of risk. *Risk assessment* is performed after risk analysis. Risk assessment combines the elements of risk analysis and weighs them against a standardized, acceptable criteria. A risk assessment model is presented in the form of a *risk assessment matrix* as demonstrated by Table 3. A risk matrix can be used as a tool to measure risk, guide mitigation factors, and for general safety management.

Table 3 *Risk Assessment Matrix*

RISK ASSESSMENT MATRIX				
	Severity			
Likelihood	Negligible	Marginal	Critical	Catastrophic
Frequent				
Probable				High
Occasional			Serious	
Remote		Medium		
Improbable	Low			

Note. Adopted from "System safety processes," by FAA, n.d., Retrieved from https://www.faasafety.gov/gslac/alc/libview_normal.aspx?id=6877

While hazard identification is key to risk management and mitigation, Ericson (2005) asserted that some hazards are more discernible than others. A foreign object on the runway is a case in point for an obvious operational flight hazard. On the other hand, poor organizational safety culture may pose hazards to operational safety, hazards that may be considerably less apparent compared to the case of a foreign object on the runway. Sound safety management programs and techniques should be able to discern such latent safety hazards. Equally, the techniques ought to be dynamic, to reflect the evolving safety considerations such as technology and human behavior (Ericson, 2005).

Increasingly, focus on safety is shifting towards organizational and environmental challenges (Liou et al., 2008; Taylor, 2012). This paradigm calls for a dynamic review of the approach that hazards are identified and risk

assessed and managed. An ideal model for safety analysis system is one that captures both traditionally engineering factors of safety as well as the emerging human and organizational variables of safety. Understanding of the metamorphosis of approaches to evaluation of safety can provide a clear indication of the dynamism of safety variables and the direction the aviation industry needs to embrace going forward.

2.2.1 Historical Approach to Evaluating Safety

Over time, efforts to improve safety through accidental-causation analysis has transitioned through three main phases as depicted by figure 1 (FAA, 2015). Ericson (2005) identifies the two main groups of safety variables as engineering design and organizational factors. The earlier years of aviation saw accidents and incidents largely caused by inadequate engineering designs (Ericson, 2005; FAA, 2015). Subsequently, safety and operational risk were evaluated mainly based on the frequency of accidents and incidents (Liou et al., 2008). Gibbons, von Thaden, and Wiegmann (2006) refer to accidents and incidents as 'lagging' indicators of safety as they provide clarity of the status of safety after incidents and/or accidents. This "fly-crash-fix' (Stolzer et al., 2008, p. 13) approach to managing safety is reactive-based and provides minimal opportunity for proactive analysis and mitigation regarding safety practices (Gerede, 2014). Rose (2006) points out that the historical method of evaluating safety can still be applied in situations that experience high frequency of incidents and accidents.

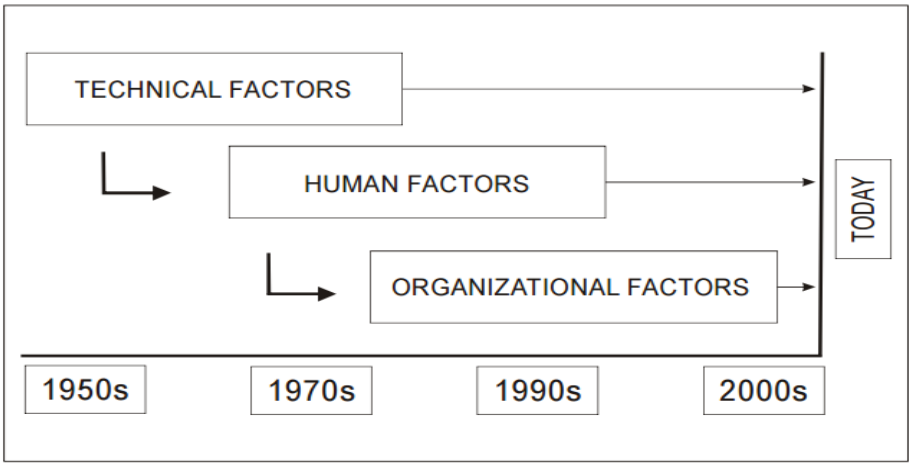

Figure 1. Evolution of the approach to safety.
Adapted from "*Safety Management System SMS explained"* by FAA, 2015

Since the 1930s and 1940s, improved engineering design and technology continue to eliminate or minimize many of the earlier hazardous design flaws (FAA, 2015). Mechanically induced accidents declined during this period. However, accidents rates were still significantly high. The ever-increasing complexities of emerging technologies presented new challenges to human and organizational capabilities. These challenges were very evident during the 1950s to 70s era. Attention turned to human factors issues due to an increase in human-error related accidents and incidents. Human factors efforts concentrated on how individuals and crews performed together, as well as with their working environment. Programs such as Crew Resource Management and Maintenance Resource Management (MRM) were introduced to address human-related safety issues. These efforts further improved the industry's safety. Gradually however, additional analysis of accidents and incidents indicated a series of opportunities that if observed, would have prevented more unsafe occurrences. These

accidents were determined to be related to organizational decisions and attitudes (FAA, 2015).

In the late 70's, management of safety started to take a more proactive viewpoint. The aviation industry started to collect and analyze more safety related data to learn, project, and mitigate recurring poor safety practices. The rates of aviation accidents and incidents have continued to decline since. However, Liou at al. (2008) note low accident and incident frequencies do not necessarily equate to a high safety standards. The Federal Aviation Administration (FAA), ICAO, and other stakeholders in the aviation safety such as operators and airport managers recognize the need to continually improve aviation safety to address all modern concerns (ICAO, 2009).

2.2.2 Modern Approach to Evaluating Safety

Traditionally, the aviation industry has taken a *reactive* approach to identifying hazards (Stolzer et al., 2008). As aviation safety improved with the advancement of science and technology, the industry acknowledged the need to be *proactive* in the industry's safety. In the proactive method, the industry actively seeks to identify hazardous conditions through analysis of the organizational processes (FAA, 2015). A proactive method relies heavily on data-analysis to identify potential hazards. Appropriate mitigation factors are then put in place to promote safer practices. While this method, currently in place, has had a significantly positive impact on aviation safety, the industry is always in need to devise newer and more effective ways to improve safety (ICAO, 2009). A predictive approach to safety is one such newer approach (FAA, 2015).

A predictive approach to safety analyzes system processes and the environment to identify potential unsafe acts. SMS embodies the predictive approach (FAA, 2015). SMS underscores the importance of attitude and the environment, specifically, organizational processes (U.S. Government Accountability Office [GAO], 2014; Stolzer et al. 2008). SMS calls for in-depth knowledge of “hazard identification, risk management, system theory, human factors engineering, organizational culture, quality engineering and management, quantitative methods, and decision theory” (Stolzer et al. 2008).

The modern technique of safety and risk management is shifting towards a heavily data-driven and risk-based practice (GAO, 2014). ICAO and the FAA are championing this approach, enshrined in a safety management architecture known as Safety Management System (SMS), to aviation communities worldwide (ICAO, 2009). SMS focuses on developing an organizational safety culture that enhances safety. Unlike historical methods, of managing safety that were more dependent on ‘lagging’ safety indicators, modern methods focus on identifying and managing latent safety variables (GAO, 2014).

Effective management of safety requires sound policies, procedures, and practices. Equally important is the behavior of employees regarding the stipulated policies, procedures, and practices. While it may be difficult to measure behavior, Taylor (2012) suggests that evaluating employee beliefs provides a good indicator of their likely behavior. Taylor proposes links between beliefs, espoused values, attitudes, artifacts, and behavior. Values are shaped by belief and determine behavior. Understanding beliefs and values as well as

organizational culture may serve as a clearer indicator of likely behavior. Belief and values that do not align with positive safety behavior may indicate ‘leading’ (Yule, 2003) safety indicators and provoke investigation into possible mitigation measures (Taylor, 2012). The ‘leading’ safety indicators allow for evaluation of hazards before occurrences of accidents and/or incidents, in essence, a predictive safety approach (Yule, 2003).

To ensure a robust safety management program, understanding of the organizational and other human factors variables becomes very vital – perhaps as important as understanding the performance of the mechanical and engineering aspects of as system. There is need for a robust data acquisition, management, and processing architecture that captures both engineering-centered as well as human factors-centered data. Effective data acquisition requires pertinent and vigorous safety reporting systems.

2.3 Safety Reporting Systems

Scholars including Liou et al. (2008) have demonstrated the significance of safety reporting systems in an organization. SMS and other modern safety programs rely significantly on data. Data has to be efficiently acquired, recorded, and properly processed to identify potential hazardous patterns. The hazards can then be remedied accordingly. Aspects such as ease of use, availability, and accessibility are important to a data reporting and data management system. Data capturing systems should also be valid, readily available, and reliable (Liou et al., 2008).

The GAIN Working Group (2004) cites legal and insurance variables as motivators for mandatory safety reporting by organizations. A major limitation of safety reporting is the tendency of humans to limit full disclosure for fear of blame or incrimination. Consequently, a significant number of incidents may go completely unreported, which may hamper efforts to improve safety. Other constraints of reporting culture include distrust of the system's confidentiality, and the workload related to reporting. Nevertheless, factors that motivate employees to report, such as perceived benefit, can improve safety reporting. Automatic logging systems and other engineering measures are possible ways to mitigate human reporting limitations. However, engineering solutions can often be difficult to implement in existing systems (The GAIN Working Group, 2004).

Stolzer et al. (2011) identifies four main streams from which data is acquired during operational risk management as *auditing*, *investigations*, *people reports*, and *data*. Audit describes data that is captured by independent teams while conducting on-site visits. An 'audit' can be *internal*, performed by the organization's own staff, or *external*, performed by an entity that is not part of the organization under review. 'Investigations' defines an assessment that takes place following incidents or/and accidents. The *data* method uses an engineering solution such as the operational flight data monitoring system (FDM), also known as flight operations quality assurance (FOQA) (Landry, 2012). People reports concerns data generated manually by personnel, such as through the suggestion box, or through telephone call. A pilot report or anonymous hotline are good examples of people reports (Stolzer et al., 2011).

2.3.1 Voluntary data recording streams

Flight Operations Quality Assurance - FOQA

FOQA is a data management system that records electronic flight parameters and aircraft systems status. Parameters, such as flight manual limitations, are subsequently analyzed for significant anomalies to help identify potential high-risk trends. According to the FAA (2014), FOQA is a voluntary and anonymous program that captures broad operational data to identify hazardous patterns such as systematic deviations from flight protocol. A significant reduction of accidents to a rate lower than the current is projected should this program be used properly. The key for the success of the program is the objectivity of the data captured as well as "application of corrective actions and follow-up" (para. 2). Due to its effectiveness, the FAA is engaging aviation communities across the world to promote the use of the program (FAA, 2014).

Mitchell, Sholy, and Stolzer (2007) propose the adoption of the FOQA program in the General Aviation (GA) sector. In addition to improving operational performance and safety, other areas of potential benefit include training and maintenance services. A major hindrance to the adoption of FOQA program in GA has been the high cost developing and certifying the program. A FOQA program for GA use (FOQA-GA) is one feasible solution to managing the cost variable. FOQA-GA is a "less sophisticated" and "autonomous system that is independent of the aircraft platform" (p. 2) but functions in much similar way to the standard FOQA programs common with major carriers and at a much lower cost (Mitchell, Sholy, & Stolzer, 2007).

An advantage of an engineering solutions like the FOQA program are their ability to transfer data automatically and in real-time. In addition to higher speeds and efficiency, automatically transmitted data overcome some of the limitations of human-data transmission methods such as non-reporting and false or partial reporting. Humans can report inadequately for a number of reasons including fear of being reprimanded and inadequate motivation to report. The accuracy of reported data is important in safety management because the effectiveness of safety promotion and mitigation factors presume a higher degree of accuracy of the data used. Another method of capturing date is through *people reports*, usually in the form of voluntary safety reporting systems (Stolzer, 2011).

Aviation Safety Reporting System – ASRS

People reports voluntary reporting systems allow users to report incidents anonymously. The Aviation Safety Reporting System (ASRS) is the most common voluntary safety reporting system in the U.S. (National Aeronautics and Space Administration [NASA], 2015). ASRS is funded by the FAA and managed NASA to safeguard anonymity of those who report safety incidents. ASRS provides a platform for personnel such as pilots, aircraft technicians, and air traffic controllers to report incidents or hazardous situations. Data can be recorded through an online electronic platform or recorded manually then mailed by surface means. Recorded data include air traffic communications, near midair collisions (NMAC), airport safety conditions or services, and maintenance practices.

According to NASA (2015), the ASRS program covers operations in flight segments such as en-route, departure, and landing. ASRS assures anonymity and immunity from punitive action to reporters if incidents are reported within 10 days of occurrence. Submitted data is stripped of all identifiable information such as the reporter and the institution names to ensure anonymity. Exceptions to legal immunity include committal of criminal offense and accidents, as well as having a prior Federal Aviation Regulation (FAR) violation within the past five years of reporting. Processed reports are made available to the aviation community for the purpose of improving aviation safety (NASA, 2015).

Aviation Safety Action Plan – ASAP.

A product of the FAA's (2002) Advisory Circular *AC No: 120-66B*, ASAP closely mirrors ASRS. ASAP encourages employees of participating airlines and certified repair station to voluntarily "report safety information that may be critical to identifying potential precursors to accidents without fear of disciplinary action" from the employer or the FAA (p. 1). Pilots, maintenance technician, flight attendants, and dispatchers are all encouraged to participate. Incidents have to be reported within 24 hours of occurrence. Other exceptions to immunity include deliberate violations of safety, criminal activity and falsification. A Safety Event Review Committee (ERC) usually comprised of representatives from the FAA, employee union, and employer, review all reports and have to reach a consensus or corrective action. The corrective action may include remedial training, which does not show up in the employee's records. In the cases where the FAA has

knowledge outside the ASAP reports, administrative actions include an FAA Warning Notice and FAA Letter of Correction (FAA, 2002).

Other anonymous and non-punitive safety reporting agencies include the Air Traffic Organization (ATO). ATO is the operational sector of the FAA that provides air navigation services in the U.S. ATO maintains its own Voluntary Safety Reporting Program (VSRP) (FAA, 2014).

The foundation of a non-punitive self-reporting system is built on the principle of trust (Hudson, 2001b; NASA, 2015). When reporting incidents, employees have to believe that their anonymity will be guaranteed and there will be no punitive measures toward them as a result. Perceived lack of trust and *just culture* can lead to lower frequency of incident reporting. The FAA (2008) identifies *reporting culture* as another characteristic of a good safety reporting system. An organization needs to nurture a reporting culture, which enhances the willingness of employees to report incidents and accidents. Additionally, a *just culture* encourages positive employee reporting behavior. Employees feel that they will be treated fairly upon reporting, yet still be held accountable for their roles. It is also important to have bottom-up communication concerning safety issues to enable management to constantly and effectively reevaluate safety policy. Safety feedback is especially important to front-line employees. An employee may feel listened to and encouraged towards a positive safety attitude and behavior such as safety reporting if they receive positive feedback on reported incidents. Safety promotion and communication reflects organizational efforts towards the promotion of safety programs.

Lower frequency of reported safety concerns may not necessarily equate to safer operations (Liou et al., 2008). Since safety evaluation and management increasingly rely on data (ICAO, 2009; Rose, 2006), the level at which safety culture is perceived to permeate an organization can affect self-reporting behavior. This underscores the need for organizations to constantly reevaluate their safety culture and climate. Other determinants of employee self-reporting include knowledge of hazards, knowledge of a hazard reporting system, and accessibility to a hazard reporting system (Adjekum et al., 2015; Hudson, 2001b). The reliability and verifiability of data captured is important as the accuracy and mitigation measures are largely based on the data. Efforts to apply analyzed data and investigate incidents as well as accidents are guided by scientific techniques as a set of theories.

2.4 Accident Assessment Tools and Theories

Heinrich's Law

Heinrich (1959) performed an elaborate examination of accidents and incidents reports in 1930s. Results from the study suggested that for every serious injury event, there had been approximately 29 accidents with minor injuries, and 330 accidents with no injuries, a ratio of 1:29:330 respectively. Reasoning that because many accidents have common root causes, Heinrich theorized that mitigating the more prone accidents that had no injuries would, in retrospect, eliminate or reduce likelihood of injury-accidents. Bird and Germain (1969) later analyzed 1,753,498 accidents that had occurred in 279 companies.

The researchers established a new ratio for accident projection, 1:10:30:600. The ratio corresponded to one serious injury accident, for every 10 minor injuries, 30 accidents resulting in property damage, and 600 incidents with no visible injuries or damage (see figure 2).

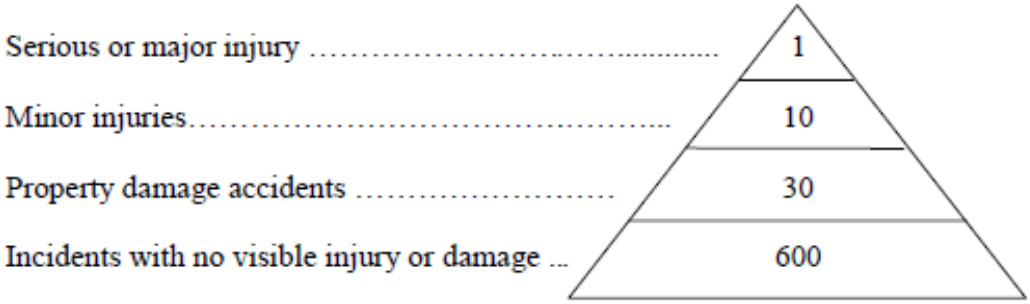

Figure 2. Bird and Germain's Safety triangle.
Adapted from "*Safety management manual*" by ICAO, 2009

Comparatively, the U.S. commercial airlines sector of air transport averages about 50 accidents per year (Stolzer et al., 2008). Of these, two are categorized as 'major', three as 'serious', 25 'with injury', and 25 'with damage'.

Heinrich's Law (Heinrich, 1959) and Bird and Germain's safety triangle (ICAO, 2006) suggest that whereas it is challenging to reduce safety risk to zero, there are opportunities for the aviation industry to be more proactive in managing safety (Bird & Germain, 1969; Stolzer et al., 2008). However, Heinrich's Law has come under considerable criticism. Manuele (2013) asserts that the Law assumes two myths:

a. Unsafe acts of workers are the principal causes of occupational accidents.

b. Reducing incident frequency will achieve an equivalent reduction in injury severity (p. 4).

Manuele's (2013) study indicated effectiveness in reducing frequency in smaller injury-free accidents. However, there was no positive bearing, or in some cases, there was negative bearing on the more severe incidents. The researcher suggests an effective and unbiased reporting of incidents is vital for safety and accidents analysis. Only then can a thorough investigation to identify latent unsafe practices take place (Manuele, 2013).

Manuele's (2013) observations mirror the current aviation industry's viewpoint that is shifting its emphasis from focusing mostly on events represented by the peak of the safety triangle, to the base (Liou, 2008; Reason, 1990, 1997; Taylor 2012). More so, the shift is also targeting elements of safety such as organizational culture, to develop and foster a more positive safety culture. Reason's (1997) Swiss Cheese model further expands the safety triangle by underscoring the need to focus on safety reporting in order to improve the chances of discovering latent unsafe conditions.

The Swiss Cheese model of human error

In 1990, Reason proposed a model of the causation of human error that was later known as the 'Swiss – Cheese' model. In the model, four slices of the Swiss cheese lined up side by side, represent the four levels of safety defenses. The levels are *Organizational Influences*, *Unsafe Supervision*, *Preconditions for Unsafe Acts*, and *Unsafe Acts,* in descending order of hierarchy. These defenses have mutable holes in them that may emerge, close up, and change in sizes. An

accident or incident occurs when a straight line can go through all the four slices or stages of a system's defense (Reason, 1990).

Reason (1997) points out *Unsafe Acts* as the most important layer of safety as it is the last line of operational defense. According to Shappell and Wiegmann (2000), the aviation industry often refers to the *Unsafe Acts* stage of system defense during accident investigation as pilot or human error. Reason (1990) denotes that *Unsafe Acts* receive the most attention during an investigation following an accident or incident. It is the action or inaction of a crew that results in an accident. *Preconditions for Unsafe Acts* describes prevailing variables, for example, fatigue and poor crew coordination that lead to poor decision-making. The decisions are wrong actions or inactions that may lead to an accident or incident. For example, a pilot may continue flight into weather minimums beyond their skills or training due to organizational pressure to arrive on time. *Preconditions for Unsafe Acts* are attributed to poor or inadequate supervision, otherwise known by the model as *Unsafe Supervision*. The general manner in which an organization carries out its practices ranging from budgeting, human resource management, and culture influences safety variables including supervision. This highest stage of safety defense is referred to as *Organizational Influences* (Reason, 2009).

An advantage inherent in the *Swiss Cheese* model is its thoroughness to investigate beyond the actions and inactions that ultimately result in an accident or incident. The model allows for identification and mitigation of latent failures

and weakness in the system's safety beyond the *unsafe acts* layer. It investigates root course of accidents in an entire system.

Grady (2014, para. 5) defined a system as a composition of "entities that work together through relationships and with their environment". Systems have an inherent ability to fail (Ericson, 2005). A system fails when it does not meet its expected requirements. Successful breaches in all layers of safety result in failures, which increase mishap risks such as injury, damage, and death. The *Swiss-Cheese* model conceptualizes accidents as a result of "successive breaches in multiple system defense" (ICAO, 2013, p. 2-3).

ICAO (2013) categorizes failures into two groups:

- Active failures – "…actions or inactions, including errors and violations, which have an immediate adverse effect" (p. 2-3).
- Latent conditions – "…are those that exist in the aviation system well before a damaging outcome is experienced" (p. 2-3).

Active failures are largely associated with front-line employees and are closely related to unsafe acts. Latent conditions may remain dormant for a long time, may fail to be viewed as harmful, and can eventually lead to accidents. Latent conditions frequently result from lack of positive safety culture, conflicting organizational goals, inferior equipment, procedural design, and faulty organizational structures or poor decision-making by the management (ICAO, 2013).

Ultimately, a desirable system is one with benefits such as high productivity, and low mishap risk. The tradeoff between hazard and benefit is critical,

especially in high-reliability organizations. Individual industries determine their own balance of risk and benefit. This balance defines an organization's safety margins and safety risk management. The Human Factors Analysis and Classification System is a safety analysis program that focuses and elaborates further on latent failures.

The Human Factors Analysis and Classification System (HFACS)

In 2002, Shappell and Wiegmann further developed Reason's (1990) *Swiss Cheese* model to elaborate more on the four levels of safety nets; *Organizational Influences*, *Unsafe Supervision*, *Preconditions for Unsafe Acts*, and *Unsafe Acts*. The researchers referred to the resultant accident and incident analysis tool as the *Human Factors Analysis and Classification System* (HFACS). *Unsafe Acts* can be in the form of *Errors* or *Violations* (Reason, 1990). Reason (1990) defines errors as efforts that achieve unintended results and violations as intentional actions or inactions designed to cause a negative outcome.

Shappell and Wiegmann (2002) sub-categorized errors as either *Decision errors, referring to poor decision making such as responding wrongly to an emergency* and *Skilled-Based* error such as applying poor technique to a flight maneuver. A third, *Perception* error, may include visual illusion that results in, for example, controlled flight into terrain (CFIT). Violations describe a blatant disregard for established rules and guidelines. Flying an unauthorized approach and failing to adhere to training rules are examples of violations. Violations are either *Routine,* occurring frequently in the organization or *Exceptional,* occurring seldom. Routine violations such as habitual speeding on taxiway by a fleet may

indicate a flaw in the organizational safety culture. *Preconditions for Unsafe Acts* include *Substandard Conditions of Operations* and *Substandard Practices of Operator.* The former category includes an *Adverse Mental State* such as complacency, *Adverse Psychological State* including mental illness, and a *Physical/Mental Limitation* that allows unsafe operational conditions such as visual limitation. The subcategory *Substandard Practices of Operators* is comprised of two subcategories, *Crew Resource Management* (CRM) and *Personal Readiness*. The CRM component entails coordination among personnel including good communication that extends to before and after a flight activity. *Personnel Readiness* describes mental and physical preparation for work, for example, getting sufficient rest to effectively focus on work (Shappell & Wiegmann, 2002).

Regarding the *Unsafe Supervision* layer, Shappell and Wiegmann (2002) designed four subcategories. *Inadequate Supervision* involves the ability of a supervisor to provide necessary motivation and guidance to an employee. Another, *Planned Inappropriate Operations* describes the level of preparation that goes into planning an operation such as allowing for adequate planning time. *Failure to Correct a Known Problem* and *Supervisory violations* concern blatant disregard for rules and regulations. *Organizational Influences,* the first layer of safety net, includes *Resource Management, Organizational Climate,* and *Organizational Process* subcategories*.* Resource Management is focused on management's decision-making process regarding allocation of resources such as personnel and finances. An organization will allocate resources in areas it

values most. Safety needs have to be accorded matching priority in resource allocations. Researchers defined *Organization Climate* as "…broad class of organizational variables that influence worker performance" (p. 11). Also known as the 'working environment', climate includes variables such as structures, policies, and culture that define how an organization operates. *Organizational Process* involves procedures and oversight of an organization's operations (Shappell & Wiegmann, 2002).

The current study focuses on the *culture* component of the *Organizational Climate* safety, a sublayer of *Organizational Influences.* This is the highest and first layer of safety. Ideally, eliminating or mitigating risk at this layer may prove the most effective method of managing latent failures. The iceberg safety model provides yet another perspective to safety analysis.

The Iceberg Model

A positive safety culture coupled with employee familiarity with a safety reporting system could promote efficient safety reporting behavior (Adjekum et al., 2015). As presented by Rose (2006), the Iceberg model describes the relationship between reporting culture, data integrity, and interpretation of data. In the model, an entire iceberg represents total risk. Visible risk, which is the observable and reported incidents and accidents, is symbolized by the visible part of the iceberg. Latent risk, not readily apparent, often not even from captured data, is denoted by the submerged portion of the iceberg. In an ideal safety management scenario, the entire iceberg would float on top of the water.

Capturing as much valuable data as possible optimizes the visibility of the entire iceberg.

The goal of SMS is to attain an organization safety culture that continually nurtures positive safety behavior such as recording of incidents and accidents (Rose, 2006). Brown, Willis, and Prussia (2001) asserted that every accident results from a failure in the organization. Tsay et al. (2014) supported the idea and suggested a weak safety culture is often the latent cause of human factors related accidents and incidents, and the cause of long term safety implications. McDonald, Corrigan, Daly, and Cromie, (2000) had earlier proposed that airlines should consider including management and organizational factors in their safety management systems. The researchers argued a comprehensive approach would be more effective in managing latent safety variables, echoing other researchers such as Reason (1997), and Shappell and Wiegmann (2000). Modern safety management systems such as SMS are designed to promote safety reporting to maximize exposure of the iceberg. They purport to make safety reporting and other positive safety behavior part of the organizational culture (FAA, 2015).

2.5 Safety Culture and Safety Climate

The terms terms safety culture and safety climate are often, erroniously, interchanged (Hecker & Goldenhar, 2014; Zohar, 2010). Although there has been a wide breadth of studies partaining to safety culture, there is no widely agreed definition of safety culture (Cooper, 2000; Patankar, Brown, Subin, & Bigda-

Peyton 2012; Reason, 1998). For example, Cooper (2000) defines safety culture as “Shared values, actions and behavior that demonstrate a commitment to safety over competing goals and demands” (p. 113). Cooper (2000) suggests safety culture as a dominating sub-component of corporate culture. As such, safety culture is a critical element of safety, especially in high-reliability organization. Patankar et al.’s (2012) definition of safety culture is “why we do what we do” (p. 5). A common thread among many of the definitions of safety culture is the inclusion of the behaviors, values, and actions elements (Cooper, 2000). Patanker et al (2012) argues that safety culture has two components, behavior and attitude. The behavioral study is concerned with understanding the link between behavior and consequences, such as accidents. The attitude component pertains to understanding of the dominant psychological status within an organization. The present study is concerned about the latter component of safety culture. The present defines safety culture as:

> A dynamically balanced, adaptable state resulting from the configuration of values, leadership strategies, and attitudes that collectively impact safety performance at the individual, group, and enterprise level. Simply stated, safety culture is a dynamic configuration of factors at multiple levels that influences safety performance. (Patanker & Subin, 2010, pp. 102)

In 1980, Zohar conducted what among the first safety climate studies. In the study, in which he developed a safety climate survey by analyzing results from factory workers in Israel, Zohar described safety climate as the perception

shared by employees of the relative importance of safety behavior in their work. In the year 2000, Zohar argued that safety climate pertains to perceptions shared regarding the priority given to safety, against productivity. Essentially, safety climate describes employee perception of the management's commitment to employee safety and health (Flin et al, 2000). The present study recognizes safety climate as presented by Patankar et al. (2012) as the attitude and opinion of employee regarding safety in an organization.

Safety culture and safety climate focus of safety though they are different constructs (Hecker & Goldenhar, 2014). Safety climate pertains to the prevailing, albeit temporal status of perception of safety in an organization, while safety culture relates to deeper long-held perceptions of underlying traits and value of safety (Patankar et al., 2012; Patankar & Subin, 2010; Seo, Torabi, Blair, & Ellis, 2004).

Aviation accident rates have improved since the inception of aviation due to sound engineering practices and adoption of effective human factors measures such as crew resource management (CRM) (FAA, 2015). The focus on improving safety by the aviation industry is increasingly shifting towards other elements of safety, such as organizational factors. Positive safety culture aims to instill perceptions and attitudes that promote desirable safety behaviors, such as reporting of incidents and accidents. Referring to safety culture as the "human performance element" (Taylor, 2012, p. 2), underscores the role of safety culture in managing safety. Lack of understanding and proper management of safety

culture can result in “failure in designated engineering or procedural safety barriers” (Taylor, 2012, p. 2).

2.5.1 Background and Development of Safety Culture

The term ‘safety culture’ is thought to have been first reported in the International Atomic Energy Agency’s Chernobyl accident report (Patankar et al., 2012; Reason, 1998; Tsay, 2015). The evolution of *safety culture* can be traced back to a series of accidents in the 1980s, mostly in Europe, that heralded the systematic evaluation and management of safety (Hudson, 2001a). Prior to the mid-1980s, safety was viewed as an individual responsibility. In 1974 a chemical plant close to Flixborough, a village in North Lincolnshire England, exploded causing 28 fatalities and 36 serious injuries. Improper engineering modifications were identified as the cause of the accident. This event, also known as the Flixborough accident, resulted in among other things, the first efforts to formalize safety plans, already in place within organizations (Hudson, 2001a).

Two years later, a chemical plant explosion in northern Milan, Italy, released a plume of dioxin over Seveso, a nearby town (Tsay, 2015). Known as the Seveso incident, its effects included animal deaths, abortions, and ailments such as nausea and skin irritation. Implications for safety included a European Union directive, 76/82/EEC, also known as the Seveso directive. The directive called for standardization of industrial safety regulations (Hudson, 2001a).

In 1988 (Hudson, 2001a; Thompson, 2015), Piper Alpha, an offshore oil production platform in the North Sea exploded causing 167 fatalities. Regarded

as the worst offshore accident in the world, the Piper Alpha accident further generated advocacy for systematic management of safety. The explosion was triggered when an employee turned on a pump that was under repair, against safety guidelines. Investigation determined that failure to follow established maintenance protocol created conditions that led to the unsafe acts of the employee in question (Thomson, 2015). The Piper Alpha accident further elicited the development of SMS. SMS was subsequently integrated into healthcare management, and later adopted by other industries including nuclear and aviation (Hudson, 2001a). Figure 2 demonstrates Hudson's (2001a) description of the development of safety culture.

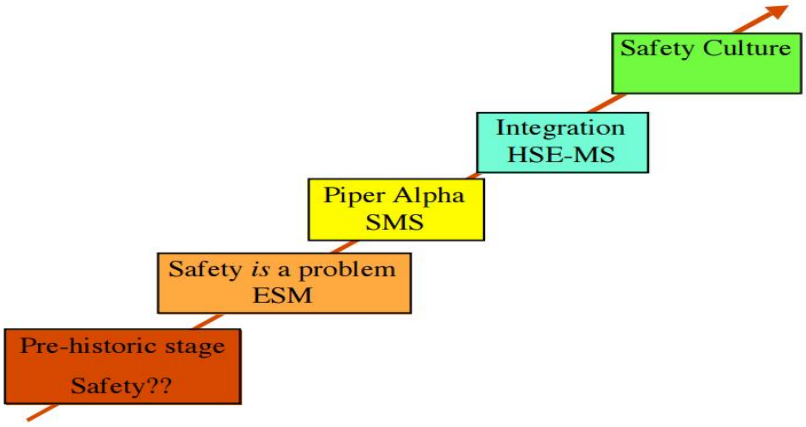

Figure 3. The evolution of safety culture

Adapted from "Safety management and safety culture: the long, hard and winding road" by P.T.W. Hudson, 2001a, *Occupational health and safety management systems*, 3-32.

2.5.2 Types of Safety Culture

Scholars have presented various ideologies of a safety culture such as Westrum's (1993) model. The well-documented model (see Table 4) has three categories, *pathological, bureaucratic, and generative* safety cultures.

Table 4 *Westrum's Original Safety Model*

Pathological	Bureaucratic	Generative
Information is hidden	Information may be ignored	Information is actively sought
Messengers are shirked	Messengers are tolerated	Messengers are trained
Responsibilities are shirked	Responsibility is compartmented	Responsibilities are shared
Bridging is discouraged	Bridging is allowed but discouraged	Bridging is rewarded
Failure is covered up	Organization is just and merciful	Failure causes enquiry
New ideas are crushed	New ideas create problems	New ideas are welcome

Note. Adapted from "Cultures with Requisite Imagination" by R. Westrum, 1993 in In J.Wise, P. Stager & J. Hopkin (Eds.) *Verification and Validation in Complex Systems, Human Factors Issues.* p. 402. Copyright 1993 by Springer

Using Westrum's (1993) original safety model as bedrock, Hudson's (2001a) developed a sequential safety culture maturity model as illustrated in figure 4.

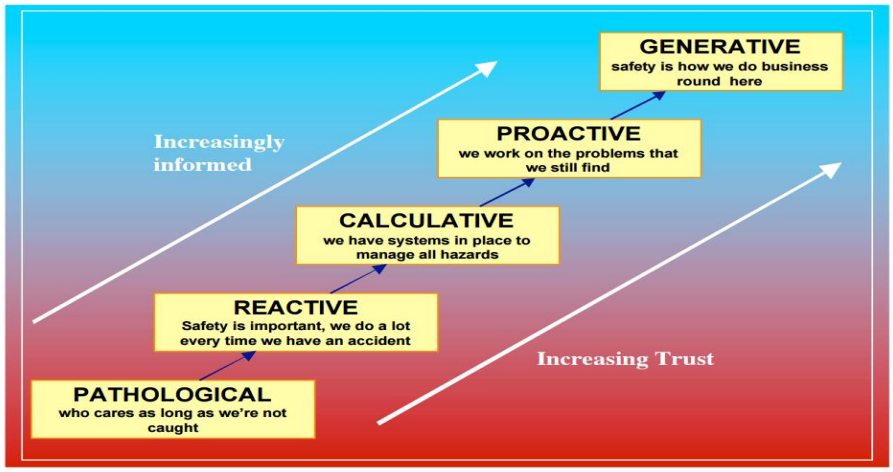

Figure 4.. Evolution of model of safety culture.
Adapted from "Safety management and safety culture: the long, hard and winding road" by P.T.W. Hudson, 2001, *Occupational health and safety management systems*, 3-32.

Hudson (2001a) cites an organization with a *pathological* state of safety culture as one that does not put any significant effort towards managing safety. Employees do not take any personal responsibilities and accountabilities for safety. In a *reactive* safety culture, an organization, usually experiencing a higher number of accidents, takes appropriate corrective measures after the fact. In the *calculative* safety culture, an organization realizes the importance of having systems in place to manage safety hazards. A *calculative* safety culture is characterized by considerations of elements such as cost-benefit analysis and quantitative risk assessment techniques in safety matters. Some form of a structured management system pertaining to safety is usually in place. While regulatory platforms can promote safer practices, a generative safety culture is ideal for optimum safety behaviors. A *generative* culture is characterized by a strong belief and conviction within and among employees as it pertains to the

importance of safety in their organization. The belief is strong to the point of almost invisibility as safety considerations become part of daily organizational and personal tasks (Hudson, 2001a).

Comparatively, the FAA (2015) groups safety culture into three categories, *reactive, proactive,* and *predictive* (figure 5). The first two categories are acknowledged by other scholars (Gerede, 2014; Liou et al., 2008; Stolzer et al., 2008) as approaches to safety management. The FAA (2015) advocates to the aviation community, the achievement of a predictive safety culture. A predictive approach to safety focuses on the environment and organizational processes to identify future problems (FAA, 2015).

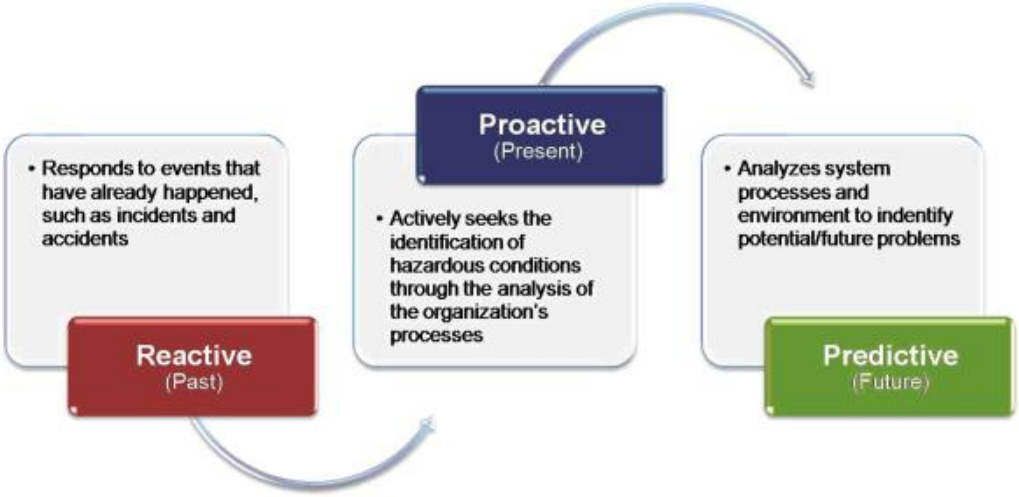

Figure 5.. Methods of identifying hazard

From "*Safety Management System SMS explained"* by FAA, 2015

The historical methods of safety management, by themselves, are not ideal for managing safety in a *generative safety culture* organization (Cooper, 2000, Liou, 2008). An examination of the perceptions of employees towards

safety procedures, systems, policies, and practices could improve the prominence and effectiveness of organizational safety in organizations with *generative cultures*. This study evaluated employee perception of their organization's safety programs and practices.

2.5.3 Evaluating Safety Culture and Safety Climate

Understanding safety culture may help identify latent unsafe safety variables and improve safety (von Thaden, 2008). Safety culture assessment is most effective when carried out by a third party specialist (Taylor, 2012), as well as when the entire hierarchy is evaluated (Cooper, 2000; Taylor, 2012; Wreathall, 1995). Involvement of third party minimizes "any possible compromise or, hierarchical pressures that may arise from an internally staffed review" (Taylor, p. 161). However, lack of validated assessment instruments is among the major challenges to investigating safety culture and safety climate (Adjekum, 2014; Patankar et al., 2012). As such, scholars have called for further research regarding validation tools (Adjekum, 2014; Chen & Chen, 2011). Nevertheless, some efforts have been successful in evaluating safety culture.

Safety culture and safety climate may be evaluated qualitatively, quantitatively, or using both methods (Cooper, 2000, Gibbons et al., 2006; Patankar et al., 2012; Taylor, 2012). Historical reviews, participant observation, group discussion, and case studies are examples of qualitative methods. A mixed method approach is ideal as it allows for a comprehensive evaluation of safety culture and safety climate (Hennick, 2014; Patankar et al., 2012). Patankar

et al. (2012) presents a more comprehensive classification of safety culture and safety assessment tools in four groups: case analysis, survey analysis, qualitative analysis, and quasi-experimental analysis.

Case studies are suitable for analyzing accidents, incidents, and undesirable events (Patankar et al., 2012). However, the retrospective nature of case studies renders them useless for events already occurred. Surveys are ideal for evaluating attitudes and opinions as well as provide the current organization safety climate standing. Surveys are practical for evaluating employee perceptions of safety. Qualitative analysis concerns techniques including interviews, field observations, and focus groups. Qualitative analyses are ideal for determining the predominant safety cultures at an organization. Qualitative analyses describe the prevailing policies, procedures, and practices in place at an organization, and how they relate to safety culture. Qualitative research may also help researchers understand organizational group dynamics, underlying values related to safety culture, as well as feedback on success and failures associated with safety. The knowledge about elements of safety culture such as perceptions of safety, safety values, and group dynamics may be useful in improving an organization's safety (Patankar et. al, 2012).

Qualitative methods allow researchers to interact directly with participants and capture participants' opinions and views (Wreathall, 1995). Qualitative approaches facilitate in-depth understanding and interpretation of data, results, and observations. Quantitative methods are easier to carry out and interpret as they follow a well-defined framework. On the other hand, quantitative methods

capture and measure data numerically. Highly standardized and calibrated, quantitative methods include well-structured interviews; questionnaires and surveys; and Q-sorts (Wreathall, 1995).

Rousseau (1990) asserted that quantitative methods are ideal for measuring an organization's responses to standardized stimuli. Standard stimuli allow for common reference points with which to base responses from and understand variations within and across respondents.

Taylor (2012) and Wreathall (1995) point out culture, and safety climate (Cooper, 2001) can vary across groups in an organization, based on elements such as profession and job function. Wreathall (1995) suggests including cross-sectional analysis in organizational and cultural studies to investigate such variations. In addition to concerns pertaining to validity of data collection tools (Adjekum, 2014; Patankar et al., 2012), another major limitation of safety climate and safety culture studies is that they only provide a snap shot of culture (Cooper, 2000; Patankar et al., 2012). Due to the dynamic nature of cultures, Cooper (2000) and Patankar et al. (2012) suggest longitudinal studies to establish safety culture and safety climate trends.

Ultimately, the use of the combined methods provides a more comprehensive study analysis (Wreathall, 1995). The current study proposed to employ both qualitative and quantitative methods. A method of analysis of safety culture is through the use of safety climate surveys.

Health and Safety Executive (HSE) (2005) defines a safety climate survey as "usually a questionnaire or interview-based method for eliciting information

regarding employees' attitudes, opinions and feelings towards safety, and its management within the organization" (p. 16). Safety culture surveys enable an organization to "monitor the success of initiatives to improve safety culture" and "Improve employee awareness of and involvement in safety" (HSE, 2005, p. 16).

Safety culture evaluation methods share similar key aspects to those of safety management systems, such as assurance of confidentiality, ease of use, and accessibility (HSE, 2005). Evaluation methods should facilitate effective communication with participants and be relevant to their area of work to realize research validity. Other considerations include the logistical aspect of accessing participants and the duration of time required for a particular method. For example, surveys that are too long may promote partial completion by participants (HSE, 2005).

2.6 Group Cultures and Safety Related Theories

Cooper (2000) views safety culture as the most significant element of as a corporate culture. Helmreich and Merritt (2001) describe corporate or organizational culture as "a complex framework of national, organizational and professional attitudes and values within which groups and individuals function" (p. 552). In 1998, Helmreich described these three structures as:

1. national culture encompasses the value system of particular nations,
2. organizational/corporate culture differentiates the behavior found in various organizations, and

3. professional culture differentiates the behavior found in different professional groups. (p. 24)

This study focused on organizational safety culture. Reason (2000) described organizational safety culture as the “ability of individuals or organizations to deal with risks and hazards so as to avoid damage or losses and yet still achieve their goals” (p. 4). Comprehensively, a safety culture can be understood as the expression of the aggregate effect of individual and group attitudes, competencies, values, and behaviors, which collectively determine the organization’s approach to safety matters (Clarke, 1999; ICAO, 2009).

Reciprocal safety culture model

Cooper (2000) advocated for examining safety culture beyond shared values and beliefs, while assessing organizational cultures. These additional elements include the relationships between people (psychological), jobs (behavioral) and the organization (situational). The reciprocal safety culture model reflects the concept of safety culture as a function of the relationship of three properties, person, situation, as they pertains to safety climate and culture under, two groups. The Internal psychological factors group refers to the *person* while the External observable factors group comprises of the *behavior* and *situation* components. The safety climate refers to individuals’ attitudes and perceptions towards an organization’s safety systems and safety environment. Safety climate may be measured through perceptual audits such as a safety climate questionnaire. The group external observable factors contain the

situation and the *behavior* components. The situation describes the safety management system in place, which can be evaluated objectively through audits and inspections. The behavior component refers to safety behavior. The organizational culture is then a product of the dynamic reciprocal associations between an organization's members' perceptions and attitudes towards the organization's goals; members' daily guided behavior; and the quality and accessibility of the organization's structures intended to support expected behavior (Cooper, 2000).

Patankar and Sabins' (2010) provides a more comprehensive view of safety culture, presented as a pyramid composed of four layered components. The B*ehaviors* layer forms the tip of the pyramid and determines safety performance. The other three layers in ascending order are *Safety climate*, *Safety strategies*, and *Safety* values. Safety climate refers to employee "attitudes and opinions regarding safety" (p. 3). Safety strategies pertain to the organizational structures such as policies and procedures put in place to manage safety while safety values refer to underlying tenets related to safety in an organization (Patankar & Sabin, 2010).

The current study proposed to investigate the three facets represented by Bandura's (1986) Social Cognitive Theory and Cooper's (2000) concept of reciprocal causation. Employee perceptions (the psychological aspect) were evaluated against employee jobs (behavior) as well as the organization's structures and environment (situation). Cooper's theory shares some parallelism to Geller's (1994) concept of group cognitive behavior.

Geller (1994) theorized that an ideal safety culture is composed of three elements, individual, environment, and behavior. The individual component defines the psychological and mental states as abilities, intelligence, and knowledge. The environmental aspect includes standard operation procedures (SOPs) as well as tools and equipment. The behavioral component comprises actions such as regulatory compliance, communication, and hazard identification (Geller, 1994). Tsay et al. (2014) cites social cognitive behavior theory (SCT) as demonstrating the relationship between safety culture and safety behavior. SCT (Wood & Bandura, 1989) emphasized that learning is achieved through observation of environment and occurs within the social context. The theory is closely aligned to the concept of reciprocal causation, “behavior, cognitive, and other personal factors and environmental events operate as interacting determinants that influence each other bi-directionally ” (para 1). Individuals, their behavior, and the environment influence each other reciprocally.

According to Parker, Lawrie, and Hudson (2006), a positive safety culture can reduce accidents in an organization by emphasizing that ‘social forces’ act upon members of an organization (p. 2). Lack of a strong, positive, social force may lead to unsafe behavior. Hudson (2007) attributes the lack of a positive safety organizational culture as the main cause of accidents such as the space shuttle Columbia accident (NASA, 2003). Parker et al. (2006) further affirms that developing a more robust organizational safety culture may have more positive implications on aviation safety compared to enhanced supervision or tougher safety procedures.

Parker et al. (2006) echoes Reason's (2000) position on the effect of safety culture on behavior, but warned the influence of an organization's safety culture eventually plateaus. To avoid the plateauing effect, organizations have to regularly capture employee feedback and revaluate remedial measures (Lee, 1998; Taylor, 2012). Employee feedback regarding their perception of the safety culture and values may be a strong indicator of their likely behavior towards safety related considerations. Feedback that reflects employee perceptions may be a strong indicator of likely employee behavior towards safety related considerations. The current study evaluated employee perception of organizational safety culture as an assessment of safety standing and culture in the subject organization.

Due to the complexities of modern organizations, the rate of development of safety culture is likely to vary between groups or sections of an organization (Parker et al., 2006). Considerations for professional cultures (Helmreich & Merrit, 2001) related to safety are also important. As such, cross-sectional safety assessments involving departments and groups in an organization may enhance thorough evaluation of an organization's safety standing. Such evaluation may allow mitigation measures to be customized to specific departmental and/or group needs. The current study included a cross-sectional design to investigate possible inter-departmental differences and professional cultural variances. The study also investigated differences in safety perceptions between front-line employees and managers.

This study proposed to investigate the airline's organizational safety climate by assessing the five basic elements/characteristics of an organizational safety culture as defined by Reason (1997). These are:

- an informed culture-one in which those who manage and operate the system have current knowledge about the human, technical, organizational and environmental factors that determine the safety of the system as a whole,
- a reporting culture: a culture in which people are willing to report errors and near misses,
- a just culture: a culture of 'no blame' where an atmosphere of trust is present and people are encouraged or even rewarded for providing essential safety-related information- but where there is also a clear line between acceptable and unacceptable behavior
- a flexible culture which can take different forms but is characterized as shifting from the conventional hierarchical mode to a flatter professional structure.
- a learning culture - the willingness and the competence to draw the right conclusions from its safety information system, and the will to implement major reforms when the need is indicated (p. 8-2 – 8-3).

Taylor (2012) also proposes that high-hazard low-risk disciplines have a "broadly agreed good safety culture practice characteristics" (p. 132). These five safety culture characteristics are:

A. Safety is a clearly recognized value

B. Leadership for safety is clear

C. Accountability for safety is clear

D. Safety is intergraded into all activities

E. Safety is learning-driven

These general characteristics form a benchmark of these industries with subtle variations depending upon the emphasis placed by a particular researcher (Taylor, 2012, p. 132).

2.7 Perceptions and Safety

Crutchfield and Roughton (2013) describe perception as a factor of safety culture. Perceptions of safety extend beyond the opinions of how the management and employees handle safety. It includes past perceptions, past style of management, approach to safety, priority given to safety, and nature of communication concerning safety related matters. Understanding the current organizational perceptions of safety is essential to any safety improvement measures including efforts to shape safety culture. An important aspect of perception is its dynamic nature, which calls for constant reviews (Crutchfield & Roughton, 2013; Gerede, 2014; Parker et al., 2006; Reason 1998).

2.8 Safety Framework in Organizations

An ideal safety environment operates on the premise of commitment to safety policies, procedures, and practices by all members of an organization. An ideal organization has a sound management structure with well-defined roles and

expectations related to safety. Additionally, the organization ought to have a vigorous and healthy hierarchical and psychological platforms and relationships that support the five characteristics of safety culture as defined by Reason (1997).

Tsay et al. (2014) stressed the importance of a well-defined organizational structure and its role in the safety management process. While developing a safety culture evaluation tool for a commercial airline, Tsay et al. (2014) presented a human-factors centered organizational safety culture assessment model. His overall model consisted of four levels: organizational system, executive, immediate supervisors, and staff. Taylor (2012) took a similar position to Tsay et al. (2014) regarding the role of organizational hierarchy in the management of safety. Taylor recognized organizational hierarchy as a significant factor of influence in safety culture. He defines the four organizational hierarchies as *executives and senior managers, middle managers, supervisors,* and *the workforce team.* Tsay et al.'s (2014) organizational system was further categorized to include safety policy, safety management system, and organizational resources and functionality.

An organization's management component consists of *top* and *immediate management*. The top management, also known as executives, are viewed as responsible for, and assessed from the viewpoint of their commitment to safety. In their HFACS model, Shappell and Wiegmann's (2000) noted that top managers are responsible for, among other variables, *Organizational Influences* that include safety climate and safety culture. Tsay et al. (2014) emphasized *immediate management*, also known as *immediate supervisors*, are evaluated

based on their activities related to safety and their attitudes. This observation also parallels Shappell and Wiegmann's (2000) HFACS model in reference to the level of *Unsafe Supervision.* Staff members are evaluated for their attitude towards safety and on their safety-related communication with their colleagues and with their superiors (Tsay et al. 2014). Liou et al. (2008) and Reason (2009) note that front-line employees are critical to airline operational safety. They form the last line of defense in a system. As such, they are equally critical in implementing and reevaluating safety management programs. It is also paramount that front-line employees adhere to the organization's safety philosophy. Equally important, is the support front-line employees receive from management, as well as that which they provide to the management through the various safety reporting channels. Feedback should be efficiently received, captured, and appropriately acted upon (Liou et al., 2008). A positive safety culture is essential for effecting their roles.

In a positive safety culture, information flows both top-down and bottom-up. A poor safety culture would customarily feature a predominantly top-down communication model. A comprehensive organizational safety culture assessment encompasses all employee levels in an organization for a more elaborate analysis. SMS is designed to optimize organizational hierarchies with defined roles and responsibilities to facilitate a smooth systematic management of safety (FAA, 2015).

2.9 Safety Management Systems

The Safety Management System (SMS) is a well-structured top-down comprehensive approach to identifying and managing risk in an organization (GAO, 2014; ICAO, 2009). Rather than establishing a separate safety system, SMS intends to integrate systematic procedures, policies, and practices within existing safety structures. Ayres et al. (2009) identified two main purposes of SMS as "… to reduce safety risk for passengers, aircraft, personnel, and property to a level as low as reasonably practical (ALARP)…" (p. 28) and to aid management in balancing operational volume, safety, and cost. Rose (2006) provides the most comprehensive objective of SMS, as attaining an organizational safety culture that continually nurtures positive safety behavior such as safety reporting.

According to Ayres et al. (2009), SMS carries with it many benefits, including:

- Reduced likelihood of accidents
- Reduced costs relating to accidents and incidents
- Assurances that a systematic process of monitoring and addressing safety issues, in a transparent and informed way, is in place
- The potential for reduced insurance and liability costs
- Competitive advantage and possibility of more business opportunities
- Improved regulatory compliance. (p. 31)

According to Stolzer et al. (2008), “SMSs provide organizations with a powerful framework of safety philosophy, tools, and methodologies that improve their ability to understand, construct, and manage proactive safety systems” (p. 1). SMS presents the latest method of approach to safety management that focuses more on organizational aspects of safety. Predecessor approaches of managing safety have focused on areas including engineering/technical and human aspects of safety.

ICAO currently requires its 191 member states to implement SMS (Mourino, 2007). The implementation is directed under Annexes such as Annex 6 – Operation of Aircraft, Annex 14 – Aerodrome, and Annex 11 Air Traffic Services. Under ICAO directives, international carriers and international airports are required to establish and practice SMS. State regulators such as the FAA encourage other sectors of aviation such as flight training to adopt SMS. The FAA (2015b) requires “most U.S. commercial airlines” (para. 1) to establish SMS by 2018. The success of SMS has led to its employment in industries such as energy and healthcare.

This study focuses on non-engineering areas of safety such as organizational culture, risk management, and decision theory in aviation that are well represented in SMS. The study examines employee perceptions of safety culture as an indicator of safety behavior, and of the subject airline’s organizational safety environment.

2.9.1 Components of a Safety Management System

While SMS is practiced in many parts of the world (Mourino, 2007), there are variations in the approach to SMS design (Chen & Chen, 2011). ICAO's (2013) SMS model has four components with 13 elements. The four components are S*afety policy and objective, Safety risk management, Safety assurance, and Safety promotion.* The SMS guiding principle issued by Transport Canada (2008) has six key components: S*afety management plan; Documentation; Safety planning, Safety oversight, Training; and Quality assurance program.*

Other SMS models include that of the United Kingdom Civil Aviation Authority (UKCAA, 2010) that has 11 components and that of the Australian Civil Aviation Safety Authority (CASA, 2005) that has eight key elements. These variations may provide some challenges when implementing the chosen SMS model. The current study recognized components of SMS as defined by the FAA (2015). The components are *Safety policy, Safety risk management, Safety promotion,* and *Safety assurance.* Figure 6 illustrates FAA's (2015) SMS model.

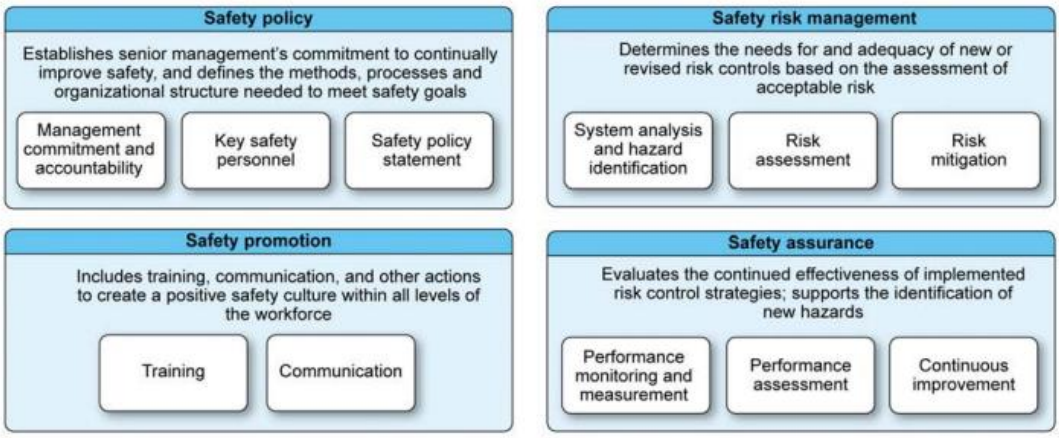

Figure 5. Components of SMS as defined by FAA (2015)

From "*Safety Management System SMS explained"* by FAA, 2015

According to FAA (2015), Safety Risk Management (SRM) and Safety Assurance (SA) are the most important elements of SMS and the most interactive as depicted in figure 6.

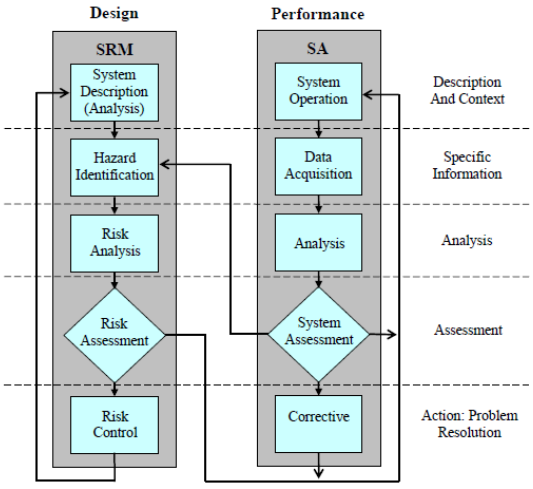

Figure 6. Interaction between SRM and SA (FAA, 2015)

From "*Safety Management System SMS explained"* by FAA, 2015

The Safety Risk Management identifies a hazard and performs a risk assessment. Appropriate risk controls are determined and applied. Safety assurance assesses the effectiveness of the risk control measures put in place. The relationship between Safety Risk Management and Safety Assurance underscores the need for a sound organizational structure with thorough authority, effective flow of information, accountabilities, as well as documentation and procedures. In addition to the four identified elements, there is an additional "…intangible, but always critical, aspect called safety culture" (FAA, 2015, para. 2).

While SMS is a robust safety management program (FAA, 2015; GAO, 2014; ICAO, 2009) and has been effective (Ayres et al., 2009), scholars have addressed safety culture as a significant variable in the effectiveness of any safety program (IATA, 2011; Lewis, 2008). This is especially so given the dynamic nature of culture and the operational environment of the aviation industry (Taylor, 2012). They dynamic nature of culture demands that it be assessed regularly for nurturing and sustaining a positive safety culture. Likewise, there is need to understand the aviation operational environment as a factor of implementing a robust safety program.

2.9.2 Aviation Operational Environment

The aviation industry consists of many systems that have to interact together seamlessly for efficiency, cost effectiveness, and for safe operations. The systems include aircraft, airports, and airspace, as well as relevant rules and

regulations. Wilke (2013) examined one such operational environment, the airport. Wilke (2013) described airports as "…complex systems involving the continuous interaction of human operators with the physical infrastructure, technology and procedures to ensure the safe and efficient conduct of flights" (p. 4). For instance, airport runway and taxiway operations need to balance the needs of five major airport stakeholders: pilots, airport operators, air traffic control, regulations, and ground handling. The complexity of the interaction of stakeholders could result in a major risk of critical failure in one of the stakeholders. Besides the infrastructural and process elements of aviation operations, human factors remain a key consideration for safety. For instance, aviation personnel are affected by the physical, psychological, and physiological factors that occur in their work environment (Wilke, 2013).

Johnson, Mason, Hall, and Watson (2001) underscore the effect of fatigue on aviation safety, especially as it pertains to three safety critical groups: pilots, air traffic controllers (ATC), and maintenance technicians. However, while the physical working conditions of pilots and ATC are fairly comfortable and uniform, maintenance technicians' work environment varies considerably with time. Maintenance technicians can be subjected to adverse working conditions such as extreme temperatures, poor ventilation, and varying moisture. Maintenance technicians may also work in small spaces that limit natural body movements. Lack of sufficient sleep, extreme temperatures, noise, and poor lighting are some of the other factors that can contribute to diminished work performance of

maintenance technician. Such working conditions can increase fatigue that can cause or contribute to latent unsafe conditions (Johnson et al., 2001).

Harris (2011) presents some of the physiological and physical stressors of pilots. Physical stressors are environmental factors such as vibration, noise, disorientation, and humidity that can “severely affect the ability of pilots to perform all tasks, such as decision making and aircraft control” (p. 160). Physiological elements such as stress and fatigue can be common in aviation personnel due to stressful working conditions, high workload, time pressure, and personal life factors. While some employees may have a higher threshold of stress, others may resort to less desirable coping methods such as use of alcohol, which may increase operational safety risks (Harris, 2011).

2.9.3 Factors of Implementing SMS

The benefits of SMS have been documented (FAA, 2015) and efforts are underway to mandate and/or promote SMS in aviation communities across the world (Chen & Chen, 2011; Maurino, 2007). Various factors affect the effective implementation of SMS programs such as the style of implementation. The role of safety culture as a significant variable in the successful implementation and management of SMS has been broadly explored (FAA, 2014; Liou et al., 2008; Taylor, 2012). All measures considered, Reason (1998) argues that, generally, persuasion not as effective in instituting organizational changes necessary for the effective implementation of SMS, but action and performance, supported by robust organizational structures as well as resources.

Overall, SMS elements should be integrated seamlessly into an employee's daily activities for smooth transition into the SMS program (Chen & Chen, 2011). Similarly, while the SMS architecture can be large and complex, ICAO (2013) and the FAA (2015) point out the scalability of SMS. Scalability allows organizations to customize the implementation and management of SMS to their sizes, resources, and needs.

The roles of organizational hierarchy from top managers to front-line employees have received much attention in the literature (Gill & Shergill, 2004; Stolzer et al., 2008, 2011; Taylor, 2012). These roles include cultivating a positive safety culture, allocating necessary resources to support SMS programs, and providing feedback upwards as well downwards. Accountabilities of job functions, duties, actions, and tasks should be clearly specified across the organizational hierarchy. While group efforts are essential to promoting SMS, Pearse, Gallagher, and Bluff (2001) and Taylor (2012) stress the significance of one's influence in the organization, as well as the level of networking one has, as key to effecting change.

One of the main challenges in implementing SMS is the lack of uniformity among the available SMS models (CASA, 2005; FAA, 2015; ICAO, 2013; Transport Canada, 2008; UKCAA, 2010). The different models may pose organizational and operational compatibility concerns as organizations operate in shared environments. From an organizational point of view, culture itself can be a hindrance to the required change. Nieva and Sorra (2003) point out that organizational change is challenging, as organizational culture is the product of

“individual and group values, attitudes, perceptions, competencies, and patterns of behavior” (p. ii18). As such, multiple intervention approaches such as training and safety promotion are vital to transforming an organization to function as a high-reliability organization. Similarly, an enabling spirit for change plays a significant role in developing and sustaining a positive safety culture (Nieva & Sorra, 2003). Incidentally, Taylor (2012) warns of attempts to completely change an organization’s culture. Instead, gradual changes with periodic reevaluation of the culture would be a more successful approach (Taylor, 2012).

Stolzer et al (2008) underscore the importance of change management in the effectiveness of SMS by stating, “Without the commitment to effective safety change management, no other aspect of SMS matters, regardless of how well-developed it might be” (p. 253). Stolzer et al. call for clarity and importance of the elements of SMS as well as a passionate commitment to the management of the change process. Ultimately, an *SMS champion* is key to leading the SMS implementation efforts. The champion should be appointed, supported, and empowered by the top management to be able to solicit necessary support and influence from other stakeholders in the organization to effect change (Stolzer et al., 2008).

2.10 Previous Studies

Scholars have explored aspects of organizational climate and safety culture (FAA, 2012; Piece at al., 2009; von Thaden et al., 2003). An overarching theme concerns the challenges of measuring safety perception and/or safety climate

(Adjekum 2015; Rose, 2006; Vick, 2002). Vick (2002) describes safety an abstract concept, and as such, difficult to objectively quantify. Rose (2006) proposed conceptualization and standardization of analyzing human-factored and organizationally related safety methods. Nevertheless, both quantitative and qualitative methods have been proposed as ideal for conducting safety culture studies (Wreathall, 1995).

Scholars have developed safety culture and safety climate assessment tools based on these methods. The tools include surveys, interviews, questionnaires, and checklists (Gao et al., 2015; Gibbons et al., 2006; HSE, 2005; von Thaden et al., 2003). A common limitation of earlier, human-centered safety assessment toolkits, is that they were mostly self-assessment questionnaires, and as such, could only measure attitudes, perceptions, and opinions. Concerns about standardization and validity of research tools have also been noted (Adjekum, 2015; Gibbons 2009; Liou, Tzeng, & Chang, 2007). Nevertheless, researchers have successfully carried out studies related to safety culture in industries including aviation and medicine, with improved validity. Often, researchers have developed their own research tools, or modified and validated existing tools (Tsay et al., 2014).

Tsay et al. (2014) developed a safety cultural assessment survey tool customized to the operational needs of China Airlines (CAL). The researchers developed the survey in consultation with CAL and other aviation industry experts. The questions developed were based on two criteria, level of employee, and demographic information. Levels of employee defined the ranking order and

included staff, immediate supervisor, and executive. Elements of SMS were divided among employee ranks based on their respective roles and responsibilities resulted in seven categories. The categories included safety policy, safety management system, safety policy, safety commitment of top managers, safety commitment by immediate supervisors, safety attitude and communication, and safety perception. Demographic information included the level of seniority and age. While the safety analysis tool met reliability and validity requirements, a notable limitation was its inability to identify weakness factors in the airline's safety culture. Recommendations included use of focus groups in subsequent applications (Tsay et al., 2014).

Earlier, Zohar (1980) had examined safety perceptions in the construction industry. The researcher observed uniformity among groups as well as variation across groups. This observation aligns with the concept of a professional-specific culture within an organization as presented by Helmreich (1998). Cox and Cox (1991) examined attitudes shared between employees that guided their perceptions and behavior towards safety. Participants were employees of a European company represented across several countries, occupation, and occupation level. Researchers identified "…personal skepticism, individual responsibility, the safeness of the work environment, the effectiveness of arrangements for safety, and personal immunity" (Cox & Cox, 1991, p. 93) as significant variables of attitude towards safety.

Gao, Bruce, and Rajendran (2015) conducted a cross-sectional safety culture analysis between four groups of China Airlines employees: flight crew,

flight engineers/maintenance, cabin crew, and ground/network operators. The researchers observed an overall positive perception of the safety climate among all employees. In addition, employment history appeared to be a factor of safety climate across the groups. Junior employees indicated a higher positive perception of the safety culture compared to seniors. This observation mirrored similar findings by Gao et al. (2013) and Adjekum et al. (2015) who recommended additional investigation of seniority as a factor of safety reporting. In addition, the ground crew operators appeared to perceive safety culture more positively, followed by the cabin crew group. Pilots reported the least perceptiveness of the airline's safety climate. The finding indicated more defined organizational sub-cultures, aligned closely with the line of work. Gao et al. (2015) recommended replicating the study with other airlines to test for generalizability of their findings. Like Taylor (2012), the researchers also recommended longitudinal studies to investigate the effect of the dynamism of policies, practices, and procedures on perception of safety (Gao, Bruce, & Rajendran (2015).

One such longitudinal study was carried out by Varjavand, Bachegowda, Gracely, and Novack (2012). Their study investigated the effect of increased risk-awareness on medical-error disclosures, a decade apart. Participants, medical interns at a university hospital, recorded an increased reporting by 33% and 26% for lower-risk and higher-risk error-incidents respectively at end of the test decade. Researchers attributed the improvements to new regulations, training, and change in attitudes as well as beliefs about error disclosures. Researchers recommended replication of the study in other geographical areas, institutions

and professional levels to test for validation and limitation of their study (Varjavand et al., 2012).

Researchers are challenged to employ more elaborate research techniques such as incorporating interviews and document review in safety culture studies to facilitate deeper understanding of an organizations' safety environment (HSE, 2005). The 'vertical slice' method is also ideal for evaluating safety culture. The method assesses "operational workforce, supervisory levels as well as management and strategic thinking in order to identify if the right information, norms, and values are being communicated down the hierarchy" (HSE, 2005, p. 38). The vertical slice method allows for determining whether down-up communication exits in an organization (HSE, 2005). The current study applied the vertical slice assessment tool to investigate the seamlessness of perception of safety between the front-line employees and the management.

2.11 Summary

Chapter 2 reviewed previous studies related to the current research. It explored the concept of safety culture, safety climate, and discussed factors of organizational safety culture. In addition, this chapter discussed safety management systems, highlighted safety framework in organizations, and explored the relationship between the perception of safety culture and organizational behavior. The next chapter will address the research design as well as research methods and analysis tools employed in the current study.

CHAPTER 3. METHODOLOGY

3.1 Research Design

Researchers (Gibbons et al., 2006; Hennink, 2014) have recommended a mixed method for safety culture studies. This research employed a cross-sectional mixed method design. Data collection techniques used in the study were on-line survey, semi-structured interviews, and focus group activities. Safety climate surveys are the most popular tools for assessing safety climate while qualitative data capture techniques such as interviews and focus groups are ideal for assessing an organization's safety culture (Hennink, 2014; Patankar et al., 2012).

The first two phases of the current study were an on-line survey and interviews. The survey had quantitative and qualitative components. The researcher utilized the quantitative segment of the survey as a tool for capturing the safety climate-related and SMS-related data. Safety climate data pertained to research questions one and four, while SMS data were pertained to research question two of the current study. The qualitative segment of the survey, as well as the interview and focus group activity, captured data useful to assessing the safety culture of the subject airline, represented by the research questions three.

The researcher analyzed results from the interview and the qualitative segment of the survey to identify common themes of interest that the researcher explored further by a focus group activity. Table 5 summarizes the design for this study.

Table 5 *Summary of Study Design and Analysis*

Research question	Element investigated	Data collection	Design and method	Tools
1	Safety climate	Survey - quantitative segment	Descriptive cross-sectional quantitative	Kruskal-Wallis H Test
2	SMS	Survey - quantitative segment	Descriptive cross-sectional quantitative	Kruskal-Wallis H Test
3	Safety culture	Survey - qualitative segment	Explorative qualitative	Thematic analysis
		Interview	Explorative qualitative	Thematic analysis
		Focus group	Explorative qualitative	Thematic analysis
4	Safety climate	Survey - quantitative segment	Descriptive cross-sectional quantitative	Kruskal-Wallis H Test

3.1.1 Quantitative Method

Quantitative methods can be used to evaluate the relationships between dependent and independent variables. Descriptive, experimental, and correlational research designs are usually carried out quantitatively. The quantitative segment of this study was descriptive and correlational. Researchers used the quantitative methods to assess, understand, and describe the safety climate of the subject airline. Quantitative method is also intended to evaluate any Key relationships between variables such as cross-groups perceptions.

According to Rousseau (1990), quantitative methods are ideal for evaluating standardized stimuli of participants. Participants are presented with,

and respond to the similar stimuli within defined parameters. The standard stimuli may be presented to participants through various ways. For instance, similar questions can be presented to participants through forms and media such as online questionnaires or interviews. Presenting a standard stimulus to participants allows a similar base from which respondents can be evaluated (Rousseau, 1990). The qualitative methods in this study were represented by the survey.

3.1.2 Qualitative Method

Wreathall (1995) identifies a major concern regarding quantitative research design as its limited ability to offer in-depth understanding of results. Qualitative methods allow for respondents' objective interpretations of experiences and meanings through words and images. The methods can also aid researchers to understand the meaning behind responses generated by the stimuli presented during a qualitative process. Other advantages include flexibility of research, ability to develop new theories, and ability to understand complex inquiry (Wreathall, 1995).

Creswell (2009) identifies four methods of qualitative data collection as *observations, interviews, documents,* and *audiovisual*. Several *observation* techniques exist which contain varying degrees of participation and observation by both researcher and participant. While *observation* allows researcher firsthand knowledge with participants, significant limitations include privacy concerns and challenges related to working with children. *Interviews* can be conducted face-to-face, through telephone, or in groups. Participants can often provide information

indirectly, which may affect authenticity of the responses and results. Researchers' biases may also affect how interviews are conducted as well as results. The *Document* technique involves collecting documents, public or private, such as diaries and newspapers (Creswell, 2009).

The document technique may offer some flexibility to researchers compared to methods like interviews (Creswell, 2009). For instance, publicly available documents may be easier to access and may present fewer privacy challenges than interview techniques. The technique captures data in participants' own language, which may improve the directness of the data. One of the limiting aspects of document technique is the potential for inaccurate or unauthentic data due to reasons such as presenter's own biases. A researcher may also have to transcribe or process data further, for usability, by methods such as scanning which adds the workload and potential limitations pertinent to transcribing. *Audiovisual material* includes sources such as films, art objects, and photographs. *Audiovisual materials* can be imaginative, allowing "participants to directly share their reality" (p. 187). Nonetheless, they may be difficult to interpret, as well as not being readily available in the public domain (Creswell, 2009).

Berg et al. (2004) point out that unlike structured interviews that only capture fixed responses from participants, semi-structured interviews present predetermined open-ended questions that allow for in-depth follow-up on questions and topics. Unstructured interviews have no standard defined questions. Instead, unstructured interviews offer more flexibility to both researcher and participant to explore areas of interest as they develop. Focus

group activities also provide similar in-depth understanding of themes and topics (Berg, Lawrence, & Lune, 2004).

This study employed focus groups and semi-structured interviews as techniques to capture qualitative data.

3.1.3 Cross-Sectional Design

A Cross-Sectional design is ideal for indicating how responses are represented across a study population (Creswell, 2009). Surveys are ideal for capturing data in cross-sectional study. Limitations of this design include difficulty in measuring change, as the study only performs a time snap shot of the variables in question. A longitudinal study may allow for trend analysis. Cross-Sectional analysis does not account for the effect of confounding variables. Additionally, it is unable to demonstrate cause and effect. The current study evaluated front-line employees including pilots, flight attendants, maintenance, and dispatch. It also evaluated the airline's management team.

3.1.4 Nominal Group Technique

The nominal group technique (Harvey & Holmes, 2012) is effective in managing focus group members' participation. Nominal group technique enables individuals to first, silently, write their ideas of a piece of paper. The papers are then pinned on a board, grouped together in similarity of opinion, ideas, or answers. Participants then discuss identified ideas regardless of who presented them. This technique allows for a higher level of involvement by all group

members. It checks dominance by some members and/or fear of participation by others. In addition to using nominal group technique, this study applied a cross-sectional design.

3.2 Study Survey

This study used survey as one of the three phases of the study. Other phases were interviews and focus group activities. The survey tool captured data to investigate the safety culture, SMS, and safety climate of the subject airline.

3.2.1 Survey Structure

The survey used in this study consisted of four sections. The sections were *salutation, demographics, structured questions, and open-ended question* section. The salutation section educated participants about the study, and invited them to participate. It also informed participants' rights regarding the study and about the informed consent. The demographics section requested and captured participants' demographic information, such as age-range, the number of years a participant had worked at the airline, and participant's gender.

The third section contained structured questions that collected data pertaining to employee perception of the subject airline's safety climate. The dimension safety climate elements assessed in the currently study were *Managements' commitment to safety, Management's Action,* and *Perceived employee* (Flint et al., 2000; Patankar et al., Seo et al., 2004; 2012; Zohar, 2000). The questions in this section also captured participants' perceptions of the four

pillars of safety management system according to FAA (2015). The pillars were *Safety policy, Safety assurance, Quality assurance,* and *Safety promotion.* Questions in this section also solicited feedback on respondents' perceptions of management's approach to managing the subject airline's safety. Each of the total seven elements under investigation (three dimensions of safety climate and four pillars of SMS) in the third section on the survey was represented by between, and including, three and seven questions. Some questions transcended to more than one element.

The questions in the third section of the questionnaire were presented in a 5-point scale Likert format. The 5-point scale items were: 'Strongly Disagree', 'Disagree', 'Neither Agree nor Disagree', 'Agree', and 'Strongly Agree'. These scale items were covariates in the quantitative research segment of this study. For this study, the highest and most positive value was 'Strongly Agree' and 'Strongly Disagree', the lowest. The researcher worded some questions such that 'Strongly Disagree' would be the most desirable option in ideal application and 'Strongly Disagree' the least desirable option. This change was done to check for internal consistency within the scale items. Concerns pertaining to Likert scales have been explored with conflicting opinions about the number of points of a scale and whether even-numbered or odd-numbered (Joshi, Kale, Chandel, & Pal, 2015). An odd-numbered Likert scale is viewed as providing more options to participants than an even-scaled Likert (Joshi et al., 2015). However, Tsay et al. (2014) argue that a 6-point scale, which is even, is useful in eliminating "…the possible ambiguous option and to collect the subjects' opinions explicitly" (p. 392)

when compared to an odd-numbered Likert scale. Regarding the comparison between a 5-point and a 7-point scale, the latter is viewed as providing more options to a participant, thus measuring a construct more accurately (Joshi, 2015). While the options of the number of point-scale may have psychological effects of the choices made by participants of the scale, the effect is minimal (Wakita, Ueshima, & Noguchi, 2012).

The last section had a provision that solicited and allowed participants to record any additional information or comments regarding the study. This captured information provided qualitative data to complement quantitative entries in the questionnaire.

3.2.2 Survey development

The challenges faced by researchers conducting safety culture studies, related to availability of research tools as well as the validity of the research tools, have been broadly discussed (Adjekum 2015). The current study used a survey modified from that of Tsay at al. (2014) and Gao et al. (2015). The current study slightly mirrors the preceding studies by Tsay et al. (2014) and Gao et al. (2015). Additionally, surveys used in both studies were validated in their respective studies.

A list of survey items were drawn from both surveys and considered for the two sub-sections of the quantitative survey under the three perceptions or dimensions of safety climate (Dedobbeleer & Béland, 1991; Flint et al., 2000; Patankar et al., Seo et al., 2004; 2012; Zohar, 2000) and the four pillars of SMS

(FAA, 2015). The list of questions underwent a further validation process. Subject experts including human factors researchers, industry professionals, professors in the aviation safety discipline, and an employee in the safety department from the subject company, provided feedback. The final list of the quantitative questions contained 20 questions, covering the three perceptions of safety climate and the four pillars of SMS.

Surveys have advantages such as multiple channels of delivery, including online, in person, and over the telephone. Surveys can be easy to analyze and some, like web-based, economical to carry out. However, there is likelihood that participants will provide inaccurate feedback through surveys. Surveys may also experience a low response rate (Aaron, 2012). This survey was administered online and used techniques that were aimed at increasing the response rate such as extending the *live* time for the survey. The survey was also administered through two media, the subject company's Intranet and the monthly newsletter.

3.3 Interview

This study employed semi-structured interviews to capture data from nine participants. Interview was one of the three phases of the study. The interview phase sought to assess respondents' general perceptions of the overall organizational safety, safety culture, and safety climate. The semi-structured Interviews had 10 key questions. The interviews were conducted over the telephone and audio recorded. The interview questions underwent a validation process similar to one described in the *survey development* section.

3.4 Focus Group Activities

Kamberelis and Dimitriadis (p. 299, 2005), describe focus groups as "…form of group interviews that capitalizes on communication between research participants in order to generate data". The focus group technique is seldom used as a stand-alone technique and is recommended as part of a mixed method approach to a study (Kamberelis & Dimitriadis, 2005), usually in a support role to a primary technique such as survey (Hennink, 2014; NOAA, 2009). This method helps to interpret results from the primary source. Scholars contend that focus groups are not intended to garner consensus, but to better understand the research topic by generating a wide range of relevant views (Hennink, 2014; NOAA, 2009). When applied correctly, a focus group may discriminate less against participants who cannot read or those who cannot write compared to methods such as online surveys (Kamberelis & Dimitriadis, 2005). Participants who would be hesitant to be interviewed individually may also be encouraged to participate in focus groups, as it may appear to be comparatively less intrusive.

Like other data collection techniques, focus groups have disadvantages. They include potential reluctance by some participants to participate in discussion because they are shy or due to fear of punitive consequences (Kamberelis & Dimitriadis, 2005); possible dominant participants, focus group activities require a less controlled environment (Hennink, 2014); and possible polarization of participants by the moderator (NOAA, 2009). As suggested by NOAA (2009) this study selected members of the same peer group to create a more favorable environment that encouraged members' participation. Focus

group activities were conducted in two separate groups based on seniority: front line employee and managers. When not properly moderated, some participants may dominate the focus group sessions (Kamberelis & Dimitriadis, 2005, p. 299). To address for time limitation, this study presented 12 questions for discussion, well within the 12 to 15 questions for an hour session of focus group recommended by Hennink (2014).

The size of a focus group is also critical in the success and productivity of a focus group session. A group's size should be "small enough for everyone to have an opportunity to share insights and yet large enough to provide diversity of perceptions" (Kruger & Casey, 2000, p. 10). Scholars have suggested group size ranges of between, and including, five and 12 participants per group (Hennink, 2014; NOAA, 2009). Hennink (2014) however suggests the nature of a study topic and type of research should have significant influence on the size of a focus group. For example, a narrower-topic and specific-research study could utilize a smaller-sized focus group than wider-topic and exploratory-type study. Following the stipulated guidance, this study utilized eight participants for the focus group activity.

3.5 Study Population

The airline investigated under this study is a US-based regional passenger airline. The airline has several divisions and operates from multiple locations in the US. The subject airline's front-line employee groups, pilots, maintenance technicians, dispatchers, and flight attendants, were the target population for this

study, as well as the subject airline's management. The subject airline was selected for ease of access by the researcher. Participants had to be at least 18 years of age, and at the time, current employees of the subject airline.

3.6 Sampling Design

Sampling is the technique used to select subjects from a population for study (Dattalo, 2008). Quantitative sampling purposes to obtain a sample that has a fair representation of the population (Creswell, 2009). Due to factors such as logistics, finance, and labor, researchers use samples to study populations. To improve the accuracy of a study and its generalizability to the population or other groups, a sample should fairly represent a study population (Dattalo, 2008). A sample design determines the fairness and representativeness of a sample to a population. It addresses how participants are selected into a sample as well as the sample size (Dattalo, 2008).

Probability sampling accords equal chances of selection to all members of a population into the sample (Dattalo, 2008). *Simple, stratified, systematic,* and *cluster sampling* are examples of probability sampling. *Simple random sampling* assigns numbers to participants in the population. A randomized technique such as a random number generator is used to select numbers that represent selected participants in the population. In *systematic random sampling*, a sequence is selected from a list of the participants of a population, based on the population's size and required sample size. *Stratified sampling* is ideal when there is need for a balanced representation from across the groups in the population. This study

applied stratified sampling in the interview and focus group phases of the study. The methods ensured equal representation of participants across the studied groups. *Cluster sampling* allows sampling from a large population or a large geographical area. *Cluster sampling* is very cost effective. However, within large clusters, participants from within the cluster have much lower probability of being selected. The probability proportionate to size (PPS) technique can reduce this error. This study employed cluster sampling in the survey part of the study. The survey was accessible to the entire population (Dattalo, 2008).

Nonprobability sampling is an alternative sampling design (Dattalo, 2008). *Nonprobability sampling* addresses some of the challenges common to *probability sampling* such as ethical concerns, cost, and time. However, n*onprobability sampling* grants unknown chance of selection to all participants of a population. This study employed *purposeful sampling* in the interview and focus group phases of the study. In *purposeful sampling,* the researcher targets participants in the population that would best serve the study's goals. For example, a researcher may select participants who are well knowledgeable in the subject area of interest. The researcher has to have knowledge of elements of the population to use this sampling method. Other n*onprobability sampling* techniques include *quota sampling and snowball sampling. Quota sampling* is similar to *stratified sampling* except *quota sampling is* non-probabilistic and it warrants the sample "…represents certain characteristics in proportion to the prevalence in the population" (p. 6). *Snowball sampling* utilizes networking to

recruit elements in the population. It is ideal when it is difficult to find suitable candidates (Dattalo, 2008).

3.7 Sample Size

According to Newey and McFadden (1994), the desired *effect size*, *alpha,* and *beta values,* determines a sample size. The alpha value defines *type I error*. With type I error, the research concludes to a false positive, or falsely concludes a treatment effect. Use of an alpha value of 0.05 is common in social sciences (Newey & McFadden, 1994). An alpha value of 0.05 limits the probability of committing type I error to 5%. The smaller the alpha value, the greater the sample size required. The *power* or *beta* value determines *type II error*. Type II error happens when a study falsely concludes there is no treatment effect while there indeed is one (Field, 2009). A beta value of 0.8 is common in social sciences (Newer & McFadden, 1994). A *power* of 0.8 gives the study an assumption that there is a probability of 80% that the study will find a treatment effect when one truly exists. The larger the sample size, the higher the power of a study. Nakagawa and Cuthill (2007) define effect size as "…a relevant interpretation of an estimated magnitude of an effect from the effect statistics" (p. 594). Effect size of approximately 0.2 can be considered small, 0.5 medium, or 0.8, large. The researcher of the current study used an alpha value of 0.05, and a beta value of 0.8 to while carrying out relevant statistical analyses.

3.8 Procedures, Administration, and Data Collection

A physical meeting to discuss the intentions of the study was held between the researcher and safety managers of the subject airline. A verbal agreement that included a non-disclosure clause was entered between the two parties regarding this study. The study was carried out under the guidelines of Purdue's Human Research Protection Program (HRPP). The researcher obtained approval for the present study from Purdue's Institutional Review Board (IRB) (see Appendix I). The study was conducted in three phases, online survey questionnaire, interviews, and focus group activities. An employee from the safety department of the subject company was the study's 'community gatekeeper', a liaison between the researcher and participants, as need arose. Krueger and Casey (2000) underscore the importance of the role of community gatekeepers. Gatekeepers can aid with the recruitment of participants; facilitate access to the population of interest; and enable accessibility to trusted and valid participants. The researcher visited the subject airline for discussions about the study. The researcher made subsequent visits to the airline and maintained communication with the liaison throughout the period of the study.

3.8.1 Survey

An approval was sought (Appendix H) and obtained (Appendix I) from the researcher institution's IRB regarding the final validated survey. A link leading to the online survey was posted on the subject airline's monthly safety newsletters and the subject airline's Intranet. The link was hosted on Qualtrics® secure

servers for reliability and privacy considerations. Data were also captured and stored on Qualtrics®. The survey link stayed *live* for a period of 12 weeks.

3.8.2 Interviews

The validated semi-structured interview questions were approved by Purdue's IRB. The interviews were conducted over the telephone. The study liaison coordinated the *purposeful* and *stratified* samplings of participants by helping to identify potential participants in each of the studied groups that were knowledgeable in the subject areas of interest. *Stratified sampling* encouraged a fair representation across the groups being studied (Dattalo, 2008). The groups under this study were *pilots, flight attendants, maintenance personnel*, *dispatch,* and *managers*. *Purposeful sampling* made more likely that participants were knowledgeable in the study subject area (Dattalo, 2008). The purpose of the interviews was to assess general employee perception of safety at the subject airline. Interviews also allow for an in-depth understanding, reasoning, and meaning of themes and concerns identified by participants (Creswell, 2009).

With the assistance of the liaison, the researcher recruited interview participants. The liaison forwarded the study's *information sheet* (Appendix A) and a recruitment statement (Appendix B) to the participants. The information sheet educated the participants on a number of aspects of the study including its purpose, participants' rights, and researcher's contact information. The recruitment statement solicited participants' participation to the study. It also informed them about participant's anonymity, length of interview, and researcher's contact information.

Some participants communicated to the researcher through email or telephone to set up the phone-interview appointment time. Participants were greeted at the beginning of the interview call. Participants were asked to acknowledge whether they had received and read the recruitment statement and the study *information sheet*. Participants were read the recruitment statement if they did not acknowledge receiving or reading a copy. A verbal consent for audio recording of the interview sessions was obtained from participants. A process for semi-structured interview was then carried out.

3.8.3 Focus group session

The study liaison coordinated the sampling and recruitment of the focus group activity. The recruitment procedures for focus group activity were similar to that of interviews. Participants to the focus group activity comprised of middle-level managers. All four groups within the focus of this study were represented by participants. As suggested by Hennink (2014), the structure of the focus group activities entailed introduction, opening session, key topics, closing questions, and a post-discussion session.

During the introduction session, the researcher and participants introduced themselves to each other for cognition. The aim of the introduction session was to develop familiarity among participants, between participants and the researcher, as well as to draw participants' focus to the study. According to Hennink (2014), the opening session is vital in building good rapport between the researcher and participants (Hennink, 2014). As part of the opening session, the

researcher read an information sheet to participants. The script educated participants about important aspects pertaining to the study and their participation. Aspects contained in the script included the purpose of the study, ethical considerations, and expectations about confidentiality. Permission to audio-record the session was then obtained verbally from participants and followed by signed consent forms (Appendix E).

Following introductory remarks were questions that focused on the key topics and themes of the study (Appendix G). These questions were designed to explore the common themes and topics identified from the analysis of results from the interview and survey segments of this study. The focus groups sessions were meant to provide comprehensive understanding of varying opinions across the studied groups. The key topics and specific questions segment of the focus group activities were essential in offering possible explanations to participants' perceptions of the airline's safety systems and their safety behavior. This information may be helpful to further improve the airline's safety environment.

As suggested by Hennink (2014), the closing questions were aimed to indicate a near end to a discussion group session. They also help to summarize items discussed, recap important elements identified during the discussion, and allow an opportunity for participants to suggest important messages and recommendation to the management or any other pertinent party.

3.9 Data Preparation

At the end of data the collection period, the online survey data were downloaded through a password-secured computer network system. A Microsoft Excel Spreadsheet was used to eliminate data entries that were incomplete. The researcher coded the responses with numerical values between and including one and five. For instance, all ‘Strongly Agree’ responses were coded as a 5, and all ‘Strongly Disagree’ responses were coded as 1. The study reverses the codes for questions that were asked in such a manner that, for example, a ‘Strongly Disagree’ response would have been a more positive response in regard to safety. Regarding the qualitative segments of this study, the researcher transcribed interviews and focus group with verbatim for analysis. According to Hennink (2014), verbatim is integral in presenting qualitative studies, especially focus group research, and with the thematic data analysis method. The researcher of the current study did not transcribe individually identifiable data, for privacy considerations.

3.10 Data Analysis

The researcher for this study used multiple data capture, preparation, and analysis and presentation methods pertinent to the type of data collected. For statistical analysis, the researcher used the Statistical Package for the Social Science (SPSS) version 43, a statistical software program. Reliability of the scale items were investigated using the Cronbach’s Alpha test. Stevens (2002) and Fields (2009) recommend a Cronbach’s alpha (α) value of at least .70 as an

indicator of an adequate internal consistency. Where applicable, a Bonferroni adjustment was performed to control for inflation of type I error Response

To analyze qualitative data, the researcher of the current study employed a deductive reasoning approach. Referring to it as a bottom-up reasoning, Trochim (2006) describes deductive reasoning as one that begins with specific observations and develops to broader generalities and theories. According to Miles, Huberman, and Saldana (2013), a deductive theory starts with a researcher reading study transcripts to obtain a general impression of the responses. Transcripts are re-read one by one, line by line. Coding involves using a phrase or word to represent the overall message identified in recorded data such as transcripts, images, and documents (Miles, et al., 2013).

Transcripts were coded based on elements such as repeated words, phrases, and sentences; statements or ideas stated explicitly as important by participants; and data that aligned with known pertinent theories and/or concepts. All the codes were reevaluated, after which some were eliminated and the remainder joined into groups of common themes. The themes were defined either purely by what data suggested as well as per elements related to the research question such as the features of a positive safety culture (Reason, 1997) and four pillars of SMS (FAA, 2015).

3.11 Validity

This study employed a mixed-method approach to research. Validity is an important aspect of research. Internal validity concerns aspects that can affect

the relationship between dependent and independent variables. Regarding qualitative research, Creswell (2009) defines internal threats as "…experimental procedures, treatments, or experiences of the participants that threaten researcher's ability to draw correct inferences from the data in an experiment" (p. 171). External validity is concerned with aspects that affect the generalizability of the study results to the population. Threats to external validity occur when "…a researcher generalizes beyond the groups in the experiment to other racial or social groups not under the study" (p. 171). Threats to a study's validity have to be appropriately addressed (Creswell, 2009).

3.11.1 Threats to Internal Validity

Salkind (2009) identifies seven types of threats to internal validity: history, selection, regression, mortality, maturation, instrumentation, and testing.

3.11.1.1 History

Studies often take place over a certain duration. Within this time, internal or external elements may have a variation effect in participants' responses. For instance, changes in policies related to the areas of the study may affect how participants respond to the study. Policies deemed favorable to positive safety culture may prompt more favorable responses regarding safety culture. This study limited data collection to 12 weeks to limit the effects of history on the study.

3.11.1.2 Maturation

Maturation refers to “changes caused by biological or psychological forces” (Salkind, 2009, p. 232). Maturation is concerned with changes occurring within participants rather than external factors. For example, a participant may gain full understanding regarding a particular safety reporting system after a lengthy study. When the said knowledge is gained within the period of the study, it may influence the participant’s responses related to the stated safety reporting system and likely threaten the study’s validity. The current study also limited the data collection time to help control maturation as an internal threat to the study’s validity.

Nevertheless, a possible effect of maturation pertaining to the current study could have been the effect of the change of policy about the Fatigue Risk Management Program, one of the many safety management programs used by the subject airline. Data indicate that within the period of the current study, a policy was instituted by the subject airline’s management to disassociate habitual citation of pilots’ for *Occurrences*, pertaining to pilots’ use of the Fatigue Management Program. The said policy was put into effect after the completion of the survey and interview phases of the current study, but before the focus group session. Data also indicates a possible influence of the changes in question, to focus group participants’ perception of safety culture at the subject airlines.

3.11.1.3 Selection

Selection refers to the influence that sampling and selection of participants may have on the results (Salkind, 2009). To reduce selection bias, a random selection and random assignment have to be performed. This study presented the survey to the population through online medium to minimize selection bias. The link to the survey was posted on the subject airline's Intranet and monthly safety newsletters. The study assumed the two platforms were accessible by all employees.

3.11.1.4 Testing

Some aspects of research such as pre-tests can influence participants' responses during a study (Salkind, 2009). This study did not employ such techniques. Equally, the researcher limited the number of the subject airline's employees that participated in the survey validation process to three, to minimize *testing* as a threat to internal validity.

3.11.1.5 Mortality

Mortality refers to attrition of participants before they complete all the required steps in a study (Salkind, 2009). Studies should be voluntary and participants should have a right to withdraw at any time they want to do so. Participants have the right to be informed of these rights. To minimize mortality, this study presented a survey to participants that was optimized for minimum length but greatest effect to investigate the research question. There were design considerations for the survey to be accessed via multiple platforms including

mobile devices and desktop computers to allow more flexibility to participants. The survey was designed for an estimated completion time of 10 minutes to minimize mortality as a threat to validity.

3.11.1.6 Threats to internal qualitative validity

Generally, generalizability is not a significant objective for qualitative research (Creswell, 2009). Focus group activities and interviews were the qualitative components of this study. Nevertheless, qualitative research is prone to other biases that affect validity and need to be addressed. The biases may include researcher biases such as tone of voice, age, and style of language that may have influence on participants' perceptiveness and responses. This study made efforts to minimize chances of bias in the questions for the focus group activities and interview sessions towards certain aspects of the study. Some practices such as leading questions that suggest what the answers should be may also threaten the validity of the study (Creswell, 2009).

Efforts to promote interval validity in the qualitative parts of the study included triangulation, as suggested by Cooper (2000). Triangulation refers to combining "multiple theories, methods, observers, and imperial materials, to produce a more accurate, comprehensive and objective representation of the object of study" (Silverman, 2011, p. 32). This study employed a mixed method approach as well as utilized interview, survey, and focus group as data capture techniques for triangulation purposes. The researcher also employed external auditors to check for internal validity as advocated by Creswell (2009). Auditors

included aviation safety subject matter experts, human factors researchers, industry professionals, and an employee in the safety department from the subject airlines. Efforts by external auditors included validation of the study's related questions and procedures. Lastly, the researcher provided a detailed discussion regarding data that was in significant conflict among participants and/or across the three phases of study (Creswell, 2009).

3.11.2 Threats to External Validity

The four threats to external validity according to Salkind (2009) are multiple treatment inference, reactive arrangements, pre-test sensitization, and experimenter effects. These threats affect whether results may be applicable to other groups. This study considered external threats to validity regarding the quantitative/survey part of the study.

3.11.2.1 Multiple treatment inference

According to Salkind (2009), participants may be given additional stimuli or treatment, which may limit generalizability of results to the population or other groups. Additional treatments should be limited or well accounted for. A section of the survey solicited an open-ended response from participants. To control for multiple treatment inference, this question was processed in accordance with qualitative procedures as explained in the section above. Regarding the semi-structured interviews, responses and analysis to the follow-up questions were identified as well as presented as so.

3.11.2.2 Reactive arrangements

Salkind (2009) describes reactive arrangements as the change in participants' behavior or responses due to the awareness that they are being watched or observed by researchers. This study did not employ an observation technique for data collection.

3.11.2.3 Experimenter effects

A researcher may influence, directly or indirectly, a participant's response (Salkind, 2009). The researcher made effort to use clear language and a neutral style of writing on the survey to limit experimenter effect.

3.12 Ethical Consideration

Canella and Lincoln (2011) assert that proper ethical standards should be at the forefront of all human-centered research. Ethical research may be used as one of the measurements of a good research plan involving human subject (Hodges, 2011). The researcher of the current study obtained permission from the researcher's institution's IRB to conduct the current research (Appendix I). In addition, the researcher observed several measures to safeguard expected ethical standards.

The researcher de-identified personal identified information from all captured data, to reduce the possibility of identifying participants, as suggested by Damianakis and Woodford (2012). The survey used for the current study instructed participants not to include any personal identifiable information in the open-ended section of the survey. The researcher did not transcribe personal

identifiable information while transcribing recorded data from interviews and the focus group session. Additionally, the analysis and reporting of the current study was conducted in a manner optimal to participants' and subject airline's confidentiality and anonymity.

Harrison and Rooney (2012) reiterate that human subject have several rights, including the right "to be properly and adequately informed about the nature, impact, and outcomes of the research and to consent to participation in the research" (p. 38). The procedure for the current study included measures to ensure participants were well informed about the purpose, impacts, and outcomes of the study, as well as sought informed consent of participation from student subjects. Interview and focus group participants were presented with information sheet (Appendix A) that contained information such as the purpose and implications of the study, as well as expectations regarding participants'' privacy and confidentiality. The recruitments statements for both phases of the study contained similar information, as well as an informed consent clause. Interview and focus group activity participants were also presented with informed consent forms (Appendix E). The informed consent form contained information such as the purpose of the study, privacy expectations, and a request to record the session.

In regard to sampling of participants for participants, the online survey was accessible through the subject airline's intranet, which facilitated anonymity and discouraged participation due to undue influence. While the subject airline's study liaison was instrumental in assisting with the process of purposeful

sampling, participants communicated directly to the researcher concerning any questions related to the study, as well as to confirm participation. This process allowed for more participants' autonomy and voluntariness

3.13 Summary

Chapter 3 explored the methods and methodology adopted in the currently study. Aspects discussed in the chapter include the research design, study population, and study sample size. This chapter also discussed the questionnaire design, methods of data collection, data analysis, survey administration, and study procedures. Lastly, this chapter explored the study's validity. The next chapter will present results from the current study.

CHAPTER 4. ANALYSIS AND RESULTS

The purpose of this study was to evaluate the safety culture and safety climate at a regional airline in the US. The specific questions associated with the current study were: 1) *What are employee perceptions of the safety climate at the subject airline among and across the target studied groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline?*; 2) *What are employee perceptions of the four SMS pillars at the subject airline, among and across the target study groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline?;* 3) *What are employee perceptions of the safety culture at the subject airline among and across the target study groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline?;* 4) *Are demographic elements such as age, gender, and length of employment, significant variables of perception of safety climate and/or safety culture at the subject airline*?

The safety climate was analyzed by capturing the subject airline's employee perception of safety through an on-line survey. The current study used a mixed method cross-sectional design. The data acquisition tools used were

interviews, surveys, and focus group activity. Data were processed and analyzed according to guidelines stipulated by the researcher. This chapter presents the results of the study. Qualitative results are presented as common themes identified from captured data.

4.1 Analysis of Interviews

4.1.1 Demographics Data

This study conducted nine semi-structured interviews. Five participants were front-line employees. Four were managers. Three of the nine participants were from the safety department and three were from the group *flight attendants*. The categories *pilots* and *maintenance technicians* had one participant each. The remaining participant was from the flight reliability department. Table 6 displays the breakdown of participants' demographics. Participants' period of employment with the subject airline ranged between one and 13 years, with an average of nine years.

Table 6 *A Summary of Interviewees' Demographics*

Job category		Rank	
Safety	3	Managers	4
Inflight	3	Front-line employees	5
Pilot	2		
Maintenance	1		
Total	9		9

4.1.2 Interview data analysis

This study employed the thematic analysis approach to analyze transcribed interviews. According to Hennink (2014), thematic analysis is one of the most common data analysis methods in transcribed data. Thematic analysis allows a researcher to immerse into data by first breaking data into finer segments. This process allows for deeper understanding of the relationships raised by participants from participants' own perspective. Interview data were transcribed verbatim as desired by the thematic analysis method, to allow researcher to effectively use quotations that capture participants' emotions (Hennink, 2014). The data were coded and then grouped into common themes and sub-themes. Themes that strongly mirrored the five elements of safety culture were identified as such.

4.2 Analysis from Open-ended Segment of Survey

This section pertains to responses from an open-ended question on the survey that prompted participants to make additional comments regarding safety at the subject airline. The survey qualitative data were generated by 27 participants who contributed in the *additional comment* section of the survey, as illustrated in table 7. Of the 27 participants, 11 were pilots, nine were maintenance technicians, and three were flight attendants. Two participants from the group *other* contributed to the qualitative survey segment as well as one each from the dispatchers and supervisory-level managers. There was no representation from middle managers or senior managers in the qualitative

survey segment. The responses were transcribed, processed, coded, analyzed, and presented using procedures similar to those employed to analyze the interview segment of this study.

Table 7 Summary of *Demographics of Open-ended Survey Segment*

Category	*n*
Pilot	11
Flight attendant	3
Dispatch	1
Manager - supervisor	1
Manager - middle	0
Manager - senior	0
Maintenance	9
Other	2
Total	27

4.3 Analysis from the Quantitative Segment of the Survey

This study performed internal reliability testing for scale items under all seven variables in this study. The variables were three of the most common perceptions related to safety culture (perceived *Managements' commitment to safety,* perceived *Employee involvement is safety,* and perceived *Managements' actions regarding safety* (Dedobbeleer & Béland, 1991; Flint et al., 2000; Patankar et al., 2012; Seo et al., 2004; Zohar, 2000)) and the four pillars of SMS (Safety policy, Safety Assurance, Safety risk management, and Safety promotion (FAA, 2015)). The last variable, Perception of management, concerned respondents' view of management's efforts towards improving safety at the subject airline. As suggested by Stevens (2002) the researcher performed a Cronbach's Alpha test to ascertain the internal reliability of scale items within all the variables. Stevens (2002) and Fields (2009) suggest a Cronbach's alpha (α) value of at least .70 as

indicator of a high internal consistency. Scale items within each variable ranged between three and seven as illustrated in Table 8.

Table 8 *Summary of Survey Variable Scale Items*

Group	Variables	Scale items (n)
Safety climate perception elements	Mgmt.'s commitment to safety	4
	Mgmt.'s actions	4
	Employee involvement in Safety	3
SMS pillars	Safety policy	5
	Safety assurance	5
	Safety risk management	4
	Safety promotion	6

The scale items within all the variables registered Cronbach's Alpha scores above .70, indicating internal consistency.

4.3.1 Demographic Information

Table 9 displays a summary of the characteristics of the sample used for this study. Eighty-nine participants attempted the online survey. Of these, 71 completed the attempted surveys. The researcher excluded incomplete surveys from analysis of the present study. Forty-six percent (n = 33) of the completed surveys were from pilots, 23.9 % (n = 17) from maintenance technicians, and 12.7% (n = 9) from the group *Others*. There were no responses recorded under the group M*anagement-senior,* while the groups Dispatch and Manager-supervisor had one response (1.4%), each. Flight attendants and middle managers constituted nine percent (n = 5) each of total complete responses.

Due to under-representation of participants in the Manager – supervisor category, the researcher consolidated this category with the Manager – middle level category in the analysis and discussion sessions. Additionally, the researcher excluded the group Dispatch from the quantitative segments of the current study due to underrepresentation of the group.

Participants were predominantly male (83%, n = 59). The largest age group range was that of 31 to 40 years (n = 25), followed closely by those in age group 41 to 50 (n = 18). Two respondents recorded their age as over 60 years, while there were no participants below age 20.

Table 9 *Summary of Participants' and Groups' Characteristics*

Variable	Categories	*n*	%	Cumulative %
Years at current work	< 1	16	22.5	22.5
	1 - 5	24	33.8	56.3
	6 - 10	19	26.8	83.1
	> 10	12	16.9	100.0
	Total	71	100.0	
Years worked with company	< 1	9	12.7	12.7
	1 - 5	17	23.9	36.6
	6 - 10	31	43.7	80.3
	> 10	14	19.7	100.0
	Total	71	100.0	
Age Group	21 - 30	12	16.9	16.9
	31 - 40	25	35.2	52.1
	41 - 50	18	25.4	77.5
	51 - 60	11	15.5	93.0
	> 60	2	2.8	95.8
	Undisclosed	3	4.2	100.0
	Total	71	100.0	
Gender	Male	59	83.1	83.1
	Female	10	14.1	97.2
	Undisclosed	2	2.8	100
	Total	71	100.0	
Job	Pilot	33	46.5	46.5
	Flight Attendant	5	7.0	53.5
	Dispatch	1	1.4	54.9
	Manager-supervisor	1	1.4	56.3
	Manager-middle	5	7.0	63.4
	Manager-senior	0	0.0	63.4
	Other	9	12.7	76.1
	Maintenance	17	23.9	100.0
	Total	71	100.0	

The largest number of participants (43.7%, n = 31) had worked with the subject airline for between, and including, six and 10 years. Twelve percent (n = 16) of participants reported to have worked at the subject airline for less than a year, the lowest frequency captured by the data.

Regarding years in current position, 33.8% (n = 24) of respondents had worked between one and five years; while 26.8% (n = 19) had worked between six to 10 years. Twenty-five percent (n = 16) and 16.9% (n = 12) of respondents had worked in their current positions for less than a year and for more than 10 years, respectively.

With job-groups as factors, flight attendants recorded to have the largest number of people who had worked with the subject airlines for the shortest time, of less than a year (Table 10). This value, for other groups, was between one and five years. These figures remained similar in regard to time range, under job category, that employee had worked at employee's current job. The management group recorded the highest age category of most participants, considering job category, of 41 to 50 years. The rest of the groups recorded most participants to be in age group 31 to 40.

Table 10 *Summary of Average Time, in Years*

	Pilots	Flight Attendant	Management	Maintenance Technician	Other
n	33	5	6	17	9
Age range	31 - 40	31 - 40	41 - 50	31 - 40	31 - 40
Years worked at company	1 - 5	Less than 1	1 - 5	1 - 5	1 - 5
Years worked at current position	1 - 5	Less than 1	1 - 5	1 - 5	1 - 5

4.4 Analysis of the Focus Group activity

The researcher conducted one focus group activity, representing the middle-level management. There were eight participants in the focus group session. Table 11 shows the breakdown of participants. The length of the discussion session was one hour.

Table 11 *Summary of Representation of Focus Group Participants*

Category	*n*
Safety	3
Flight attendant / Customer service	1
Flight Operations	1
Dispatch	1
Maintenance	2
Total	8

4.5 Research Question One

What are perceptions of the safety climate at the subject airline among and across the study groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline?

The null hypothesis for this question was that there were no significant differences between the studied groups regarding perception of safety climate at the subject airline. For this question, the studied groups were the response variables and participants' scores, the independent variables. To determine the appropriate analytical approach relative to applicable assumptions, the researcher assessed the distribution of data as it pertains to normality, and then assessed the constant variance of the data.

The Analysis of Variance (ANOVA) was used where data indicated symmetry/normal distribution and constant variance, according to Fleiss, Levin, and Paik (2013). Alternatively, as suggested by Fleiss et al. (2013), the researcher employed the Welch analysis for data that appeared to be distributed normally, but without constant variance. The researcher performed a Kruskal-Wallis H test for data that appeared to be asymmetrical but with similar distribution and constant variance, to determine whether there were any statistically-significant differences between the studied groups. Noether (2012) recommends the Kruskal-Wallis for both continuous and ordinal dependent variables. Advantages the Kruskal-Wallis test has over other statistical analysis options such as one-way Analysis of Variance (ANOVA) include the disregard for normality assumption and lowered sensitivity to outliers, as well as its ability to accommodate ordinal data (Noether, 2012). The researcher used an alpha value of 0.05, for all calculations, standard in social sciences (Newey & McFadden, 1994), to limit the probability of committing type I error to 5%.

4.5.1 Between-groups safety climate comparison

Test of assumptions for this question indicated skewed distributing among the groups Maintenance and Other regarding perceived Management's commitment to safety. All five elements of safety climate reported p values above .05, relating to the assessment of homogeneity, indicating constant variance across the all job categories. The Kruskal-Wallis test investigated whether any of the studied groups were statistically different in their perceptions of safety culture at the subject airline. Figure 7 illustrates a statistically significant

difference among employees with regard to the variable, Management's commitment to safety, in the Kruskal-Wallis nonparametric testing.

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Mgmt_Commit_Safety is the same across categories of Job.	Independent-Samples Kruskal-Wallis Test	.008	Reject the null hypothesis.
2	The distribution of Perceived_Employee_Involvement is the same across categories of Job.	Independent-Samples Kruskal-Wallis Test	.160	Retain the null hypothesis.
3	The distribution of Mgmt_Action is the same across categories of Job.	Independent-Samples Kruskal-Wallis Test	.094	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 7. Between-groups nonparametric safety culture testing

Figure 8 provides evidence that the statistical significant difference observed in the perception Management's commitment to safety, is due to significant difference between maintenance technicians and flight attendants, with a *p* value of 0.008, in the pair-wise comparison.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Maintenance-Pilot	13.762	6.035	2.280	.023	.226
Maintenance-Manager-middle	17.186	9.600	1.790	.073	.734
Maintenance-Other	18.908	8.334	2.269	.023	.233
Maintenance-Flight Attendant	34.453	10.285	3.350	.001	.008

Figure 8. Management's commitment to safety: Job-group pair-wise comparison.

To assess whether there were variations among all employees pertaining to the three perceptions of safety climate considered in the current study, the researcher first transformed data wide-to-long through the SPSS statistical software program. The researcher performed a Mixed-model linear assessment. Table 12 indicates no statistically-significant difference in employee perception, as a whole, of the three elements of safety climate at the subject airline (ρ = .074)

Table 12 *Among Group Safety Climate Test*

Source	Numerator df	Denominator df	F	Sig.
Intercept	**1**	70.000	1175.883	.000
C_index	4	280.000	2.161	.074

a. Dependent Variable: C_score.

4.6 Research Question Two

What are employee perceptions of the four SMS pillars at the subject airline, among and across the target study groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline?

Statistical procedures for this question were similar to that of question one. Between-employee perception of the four pillars of SMS. Figure 9 shows results for cross-group comparison among the studied groups, regarding the four pillars of safety.

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Safety Policy is the same across categories of Job Category.	Independent-Samples Kruskal-Wallis Test	.033	Reject the null hypothesis.
2	The distribution of Safety Assurance is the same across categories of Job Category.	Independent-Samples Kruskal-Wallis Test	.017	Reject the null hypothesis.
3	The distribution of Safety Risk Management is the same across categories of Job Category.	Independent-Samples Kruskal-Wallis Test	.009	Reject the null hypothesis.
4	The distribution of Safety Promotion is the same across categories of Job Category.	Independent-Samples Kruskal-Wallis Test	.028	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 9. Cross-groups SMS pillars comparison

Figure 10 indicates statistical significance across all four pillars of safety culture, with ρ values ranging from .009 to .028. For pairwise comparison, figure 13 indicates that the significant relationships across the four pillars are due to differences in perception across all the four pillars between maintenance technicians and flight attendants (ρ = .019).

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Maintenance-Pilot	11.098	6.042	1.837	.066	.662
Maintenance-Other	11.876	8.343	1.423	.155	1.000
Maintenance-Manager-middle	14.265	9.610	1.484	.138	1.000
Maintenance-Flight Attendant	31.965	10.296	3.105	.002	.019

Figure 10. Pairwise comparison for the four SMS pillars

Among groups comparison

Table 14 indicates statistical difference among employees perception of the four pillars of SMS.

Table 13 *Among Group Test*

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	70	1349.639	.000
P_index	3	210.000	478.003	.000

a. Dependent Variable: P_score.

4.7 Research Question Three

What are perceptions of the safety culture at the subject airline among and across the studied groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline?

4.7.1 Results of Responses from Interview Sessions

4.7.1.1 Safety Resources

Regarding the general knowledge of safety programs at the subject airline, of the 11 safety programs identified by participants, seven of the nine participants indicated they regarded the ASAP program highly, followed by FOQA and the Fatigue Risk Management Program (FRMP). Two participants indicated a of lack of clarity regarding the choice of which safety reporting system to use in the event of a safety incident. “[Referring to IRS and ASAP safety programs] …to be honest I kinda get the two mixed up sometimes…” one of the two participants illustrated. All non-safety personnel (six) acknowledged some level of interaction with safety personnel. The most common interactions with safety personnel identified by all six non-safety personnel, was in the form of initial training or new-

hire training and annual re-training, as well as through safety-related publications. All participants were familiar with safety-related publications, notably, the monthly safety newsletters and safety memos. All participants also indicated they received safety education and information through safety training, monthly safety newsletters, or safety memos.

All flight attendants emphasized the significance that the new-hire training and the annual re-training contributed to their knowledge of safety, as well as the positive impact on flight operational safety. In stressing the value of training, a participant stated"…safety starts literally from initial training… safety is the primary focus of our training". Another flight attendant felt that flight attendants were "trained at the same level of safety as pilots. So, there's really never a time when we are not equipped to handle a specific event or emergency".

4.7.1.2 Perceptions of safety across groups in the subject airline.

Two questions were used to assess participants' perceptions of the job categories or departments in the subject airline they regarded as most safe, as well as job categories or departments they felt were least safe. On the question concerning the safest departments in the subject organization, three participants named the pilot group as the safest, while two participants identified the flight attendant group as the safest. One participant each selected the safety department and the maintenance group as safest. Regarding the rating of unsafe groups in the subject airline, four participants proposed the maintenance group as the least safe, one participant proposed the flight group as the least safe, and

another participant suggested that all individuals in the organization share equal responsibility for safety standing.

Some of the reasons provided by participants for selecting the pilot group as the safest group include the pilots groups good “reporting culture”, length of time the group has been reporting, greater engagement in safety programs, and the group’s nature of being the “most cautious”. In addition, two participants credited their choice of pilots and flight attendants as safety groups to what they described as the integration of safety-risk management protocols in to the two groups’ tasks such as by pilots’ use of checklists and standard operating procedures. Of pilots, a participant explained, “[safety] …it’s just integrated into everything we do”. The participant added, “The manual if you comply with SOPs and stuff you’re complying with safety in-built into the manual. Just make sure that you stay within the safety footprint”.

One participant noted that the difference in the perceived high active-risk associated with pilots’ and flight attendants’ role compared to perceived lower-risk with the maintenance group as reason for the participant’s highest and lowest ratings for the two groups respectively. The participant explained “I think they [pilots] tend to be more cautious than anybody because they’re flying the airplane, and they are the one putting passengers and other people directly at risk. [Of maintenance technicians having a different view] its looks fixed in my opinion sitting on the ground, [while it would be] a little too much for comfort for me [crew] because I would be flying a couple of hundred passengers. I think that’s why crew tend to be more cautious about safety than anybody else”. A

“historically” relatively better reporting and just cultures environment pilots operate within, compared to other groups in the organization, was also mentioned by a participant as an additional reason for cross-groups differences as it regards to view of safety standing among groups.

4.7.1.3 Perceptions towards Management

While all interview participants portrayed senior management as largely disengaged from front-line employees, this view contrasted across the various groups and scenarios. For instance, vice president of safety at the subject airline was credited by a participant for improving safety at the subject airlines in recent times “since our VP is here now… …the level of safety is higher than it was”. Four of the participants attributed the positive feedback regarding progress of safety at the department, to the supervisory and middle management levels of leadership. One participant indicated a relatively closer relationship between middle management and flight crew as one of the reasons the participant viewed the flight operations department as safest.

Over half of participants cited detachment by senior managers across the entire organization in the increasing order: the pilot, flight attendant, safety department, and maintenance technician, respectively. These participants also indicated the disengagement by the management as one of the major challenges in the effective promotion of positive safety culture within the organization. Identified forms of detachment included insufficient physical presence, ineffective accessibility through phone and/or email, and the level of interest by

management regarding analysis of safety data. Regarding the need for more senior management involvement, one participant stated, “getting a sound audience with executive management… to listen to our concerns because we see the data like no one else”. Another noted, “Oversight from the maintenance to management, I don’t think it’s really there, they [senior managers] don’t seem to be committed to being out on the line, out in the hangar lots of the times”. Another contribution concludes, “I think for my recommendations would be for upper management to be open to suggestions”

4.7.1.4 Areas of notable progress

All interview respondents indicated that safety had improved in the recent past and expressed high hopes of progress regarding safety. This study did not establish the specific timeline suggested by participants. One participant expressed his optimism, “I think people want to embrace safety...” “[the] company came a long way in addressing safety issues” another participant weighed in. One urged the subject airline not to “stop this train of improvement”, while another concluded “I think generally as a company we are headed in the right direction”. One participant however highlighted the challenge that lies ahead concerning improving safety, “I think we still have a long way to go, but I think it will take a long time. I think we have a long way to go because we have to let the old go, the punitive”

Flight attendants indicated that flight attendants at the subject airline were developing a positive attitude towards, and increasing their participation in the

ASAP program. They proposed that increased realized value of the ASAP program and the increased knowledge about the ASAP program, specifically, its non-punitive nature, as two main reasons for the more positive acceptance of the ASAP program among flight attendants. Flight attendants cited two benefits as most important to have been realized by the ASAP program; increased knowledge about turbulence-related safety issues and increased understanding of pilot-flight attendant interaction, as it regards to safety. A flight attendant identified some of the benefits of the improved pilot-flight attendant CRM to include a more streamlined common safety-related phraseologies, which the participant alluded to, as having promoted clearer communication between the two groups. This, the participants alleged, had been critical to improving safety, particularly related to turbulence "[of improved streamlined phraseology]…and the injuries a year later show that obviously it worked", the participant concluded.

Overall, all participants expressed a generally optimistic outlook on safety in the organization.

4.7.1.5 Areas of potential progress

Safety Reporting

The pilots group was identified by four participants as having the best reporting and safety cultures. On the other hand, some participants also expressed the need to improve the two cultures across the entire subject airline. Data suggested the ASAP program remained largely unpopular among maintenance technicians, and was still in the "learning curve" among flight

attendants. Unjust culture, poor reporting culture, and demanding working conditions such as time pressure, were cited by some participants as among the main reasons they thought the maintenance technician group was the least safe.

Three participants indicated the Incident Reporting System, a predecessor to the ASAP program, as the least well-regarded safety reporting program. Participants pointed out the punitive nature of the Incident Reporting System program as the main reason for its unpopularity. While all interview participants demonstrated knowledge of multiple safety reporting programs, two participants indicated lack of confidence as to which program to use to report an incident, especially among the non-pilot group.

Fatigue Risk Management Program (FRMP)

There was mixed feedback regarding the FRMP from two participants. One suggested “Pilot trust in fatigue management program which is getting better…” However, another participant took a more reserved view “some people complain about it with our fatigue program… …because if it is a self-induced fatigue and I think that creates an environment where some people will not call in fatigue because of fear they may get some sort of discipline action”. The participant concluded “I think an area of improvement would be on the fatigue part is not issuing an occurrence to someone if they feel they should not, or are too tired to fly”. The ‘penalty’, explained the participant, was in the form of an ‘*occurrence*’.

Another area of improvement as identified by two participants was dealing with sense of “invincibility” and “complacency” among some flight attendants regarding their disregard to take appropriate action during occurrences of

turbulence. “I know what the pilot said, I know there’s going to be turbulence,… …I have been doing this for a long time, I know what I am doing”, one participant explained as an illustration of ‘invincibility’ attitude allegedly common among some flight attendants, following a warning from the cockpit crew pertaining to an imminent turbulence event. “…that’s the issue we’re battling”, the participant concludes.

Pressure to complete work in time was highlighted by three participants as common among maintenance technicians. One participant indicated that pressure from management is common. Another participant alluded that, pressure out of the need to keep aircraft flying was just the nature of the job. Time was limited, the participant explained, due to the limited time an aircraft is available for maintenance service, number of aircraft that need to be worked on, and the number of items that each aircraft need to be worked on. One participant suggested a psychological reason, that in addition, they simply work had because they “don’t want to put pressure on our passengers, where passengers are waiting out on the tarmac”.

4.7.2 Results of Responses from the Open-ended Survey Question

4.7.2.1 Results Pertaining to Pilots

Reporting, Informed, and Informed cultures

Eight of the nine participants indicated they viewed the pilot group as very safety conscious, including healthy reporting and informed cultures. Among the reasons provided for this viewpoint included a high reporting frequency and

prevalence of reporting systems such as FOQA, “LOSA”, and ASAP. However, six pilot participants inferred hesitation among pilots as it pertained to making fatigue and sick-day calls to what participants cited as “punitive”.

Pilots’ fatigue management program

Comments regarding the subject company’s fatigue management program included “Fatigue is STILL a big deal”, “I don't feel our fatigue or sick call policies are in the best interest of safety”, and “Fatigue policy can be punitive and crews are always expected to extend part 117 duty times…” One participant indicated that *fatigue calls* are generally not well received by the management and/or the scheduling department. The participant expressed “Call in fatigued, and you will most certainly get some attitude from the company at some level. When was the last time that the company pulled crewmembers pre-emptively for likely being fatigued?” One participant suggests that fatigue is “not taken seriously” because it is “less easily quantifiable safety issues” and its effects “hard to measure”.

Cost and productivity versus safety

Data suggested a consensus that productivity and cost effectiveness were more important than safety. One participant argues that aircraft and passenger safety are usually a priority but adds, “However there are times where a pilot on the verge of a fatigue call, or telling or asking crew scheduling about his/her duty limitations are, where safety is dropped for completing the flight”. Another participant warned, “Do not allow money to be the deciding factor when it relates to safety, but that's all this company cares about is money”. A pilot participant

adds “The idea that it is normal, or acceptable to deviate from the FOM/GOM, SOP, or FAM as a matter of routine should be seen as a major failure of the safety culture at “deleted”[subject airline], but it is accepted by management because it doesn't hurt their bottom line”. Sentiments towards this position were also more pronounced among responses from maintenance technicians. These sentiments included “accomplishment is still the priority, not safety” and “I have witnessed mechanics, supervisors, inspectors, managers, and directors all ignore safety in lieu of production goals”. The researcher was unable to substantiate these claims.

Routine safety violations

While there was a strong consensus that there was habitual disregard for safety across the subject organization, data also indicated specific routine safety violations. One of the stronger comments was that subject airline had “fostered” a “the culture of noncompliance” and “encouraged” “deviations. For instance, a participant claimed, “99% of flights depart with the same violation of SOP ‘dropping the brake’". Another mentioned the health and safety concerns posed by excessive dust from sanding and grinding works. According to the participant, as the sanding and grinding machines have safety guards and dust covers removed, employees were exposed to excessive dust, which makes it difficult for the sanders to have a clear view of the tools, hence heightening hazards. One participant alludes to policies and manual that “cannot be reasonably complied with” as reason for noncompliance. The participant explains “The idea that it is normal, or acceptable to deviate from the FOM/GOM, SOP, or FAM as a matter

of routine should be seen as a major failure of the safety culture at [subject airline]". The researcher was unable to verify the stated claims.

Other safety concerns mentioned by participants included alleged incidences of "very" inexperienced pilots flying the "left seat" so they could attain 100 hours, usually at the expense of more experienced captain, and well as overreliance on two captains crews when a first officer in not available, a moved indicated by the participant as prohibited by other airlines.

4.7.2.2 Maintenance Technicians

Productivity versus safety

Similar to pilots' expression, many maintenance technicians felt the subject airline prioritized productivity more than safety. Data portrayed unlearning and inflexible cultures as dominant within the maintenance community. The systematic ignorance of safety concerns was described as prevailing among all levels of employees including maintenance technicians, supervisors, inspectors, managers, and directors. Data also suggested that safety policies only for "show" and not "enforced". One participant described managers as "bully" towards frontline employee when safety "issues are brought up".

Other notable concerns

A participant indicated safety concerns regarding employees who were physically handicapped, in the event of an emergency. The participant did not identify the specific safety hazards but suggested relocating employees in question to the first floor, would mitigate the implied hazards.

Another safety concern pertained to maintenance technicians, and addressed the manner in which aircraft were habitually staged while undergoing maintenance procedures. Often, technicians worked under and around an aircraft that is supported on a single bottle jack with both bottle wheels; this, despite the lack of a safety stand, which should be in place in case the jack should fail, topple, or punch through the floor, as has supposedly happened, multiple times.

4.7.2.3 Flight Attendants

A flight attendant felt pilots were “very” safety minded and that “most” flight attendants did not “comprehend the hidden safety issues impacting, or affected by… [their]… job and/or actions”. “The general lack of job happiness is ubiquitous with both the flight deck crew and cabin crew” added another, and as such, the participant “hardly” sees “anyone going the extra mile to do their jobs above and beyond just the bare minimum to not get fired”. A third respondent identified the galley cart as the main hazard among flight attendants’ job during flights. The flight attendant linked the hazard to the carts’ movement, weight, and size, recommending research into the use of ‘half carts’.

4.7.2.4 Other

A participant from the group Other suggested that safety is promoted less by the subject airline to employees who do not work directly on aircraft. “The company only hears what it wants to hear”, wrote another participant. The participant added that employee safety reporting was low because of a punitive approach by the subject airline.

4.7.3 Results of Responses from Focus Group Activity

The purpose of the focus group activity was to gain deeper understanding of common themes identified from the survey and interview segments of this study. From the thematic analysis of the transcribed data, the researcher identified eight common themes. The themes included safety-operations balance, communication, the ASAP program, and discrepancies in reporting across groups. Other themes developed from the data were feedback, fatigue management program, crew resource management, and possible areas of safety concerns.

4.7.3.1 Safety versus operation/business balance

Four participants identified that decisions regarding the balance between safety and business interests were the most significant and frequent challenge they faced. “It’s always challenging to balance safety versus operations” noted one participant, as another confirmed, “I would second what the commenter has just said, that, it is always a balance between safety and operations”. Among reasons proposed by some of the participants as contributing to the challenge in maintaining the balance, include the faster pace of expansion of the subject airline, concerning employee size, size of operations, and greater geographical reach.

4.7.3.2 Communication

Data suggested an overall poor communication throughout across all departments and hierarchies of the subject airline. A participant suggested

communication efficiency has not kept up with the rate of expansion of the airline. Another participant suggested that the expansion of the airlines had increased vertical separation between employee hierarchies and had also affected communication between the hierarchies negatively. The geographical expansion of the subject airline was also cited as a factor of poor communication by a participant. Yet another participant suggested the fast pace of growth, rather than the growth itself was a negative variable to effective communication. Elements cited by some participants as most susceptible to poor communication included safety-specific information, time sensitive information, and bottom-up communication.

4.7.3.3 ASAP program

Responses to the ASAP program was overwhelmingly positive and optimistic among all participants. The program was cited by all participants as vital to identifying safety issues and prompting relevant solutions for the identified safety issues. In addition to safety related data, a participant reasoned that other benefits included information useful for personnel management, regulations, and financial decisions. Two participants agreed that the ASAP program working in tandem with the FOQA program provides a basis for a robust safety management system. However, one comment suggested the program was relatively new among maintenance technicians and another suggested it was reaching maturity among flight attendants.

4.7.3.4 Discrepancies in incident reporting across studied groups

Various reasons were given by participants for the differences in reporting culture across groups in subject airline, as suggested by results from interviews and survey. Three participants argued that safety issues related to flight attendant and pilots tended to be more definitive, compared to those experienced by maintenance technicians, hence were likely to be reported by the former groups. Two participants cited that often, mistakes or errors made by flight attendants and/or pilots were likely to be noted and/or reported by external groups such as air traffic controllers or data programs such as FOQA. This factor, the participant argued, compels pilots and flight attendants to report safety incidents, compared to the maintenance personnel who, according to the participant's view exercised a more flexible discretion. Pilots in particular, a respondent added, were motivated to report incidents by the ASAP's program element that protected their licenses when they reported correctly and qualified for the inferred protection. Another comment suggested that quicker feedback encouraged reporting from pilots. Yet, another proposed that pilots, by nature, felt personal obligation to report incidents that they thought would be helpful to other pilots and the company.

Numerous reasons were proposed by several participants for the weak reporting culture. One suggested that maintenance technicians "just aren't as comfortable" reporting. Two participants contend that, by nature, humans are slow to change, and given the ASAP program was relatively new among maintenance technicians (compared to the pilot group), reporting was likely to

improve with time. As an example, the participants drew comparison to the fact that trust was now fully developed among pilots as it regards to the ASAP program, partly due to the length of time the ASAP program had been in place among pilots. The two participants also related the still growing trust among pilots concerning the FOQA and fatigue management programs, as well as among flight attendants, in regard to the ASAP program. Additionally, lack of quick feedback, three participants proposed, may have created a sense that incident reporting was not valuable, hence unnecessary, to employees exhibit low incident reporting.

4.7.3.5 Fatigue management program

"The fatigue program is really tough… I think a lot people were probably flying fatigued", noted a participant, but added that the program had undergone some changes since the researcher of the current study had completed the interview and survey segments of the current study. A contentious element, continued the participant, had been regular accrual of "occurrences" to pilots' records following some fatigue-calls, which, according to the participant, pilots largely viewed as punitive. Two participants discussed and disagreed about whether "occurrences' on one's record constituted something negative or otherwise. A major change that had been done to the fatigue management program, explained another participant, was the removal of 'occurrences' from all fatigue-calls, and that, as a result, fatigue-calls had increased. The second contributor mentioned that there had been concerns of individuals abusing the

program. However, the participant continued, improved education about the program had resulted in the program being abused less. The first contributor to this theme warned that lack of same level of privacy and anonymity expectations associated with other safety programs such as ASAP remained a challenge to overcome regarding the fatigue management program. Nevertheless, the participant suggested that more changes to improve the program should be expected.

4.7.3.6 Crew resource management (CRM)

Participants identified several employee relationships across the groups that affected their performance as well as safety considerations. These relationships included the executive versus middle management versus front-line employee; pilot versus flight attendant; pilot and flight attendant versus senior management; and pilot vs dispatch.

One participant proposed that whereas there were CRM issues between pilots and flight attendants, often, the two groups are agreeable to some of the issue, but the groups would often be pitted against the management, in respect to the specific issues they would have agreed on. “[Regarding differing management’s views]…the management think it’s a whole different situation, they have a different perspective”, a participant elaborated. A case in point, the participant added, was lack of guidance from the management concerning differing emergency guidelines between the two groups. Regarding pilots and dispatchers relationship, a participant explained that it is often lack of effective

communication that may lead to misunderstanding and mistrust between the two groups. For example, a new fuel procedure that is communicated to one group and not the other, may cause confusion to the uninformed group, stated the participant. Poor communication, believed four participants, was the main reason of sometimes-poor relationship between the airline's hierarchies levels, often leaving middle managers feeling "stuck" in the middle.

4.7.3.7 Suggested possible areas of improvement

While poor communication was cited by majority (five) of participants as a chronic issue company-wide, one participant expressed liking improvements related to communication. Another participant cited pro-activeness in risk assessment before implementing new policies and procedures as positive elements, while another participant acknowledged the important role played by the union as pertains to improving safety.

Some elements were identified by a few participants as priority-areas, as it relates to safety culture. A participant was concerned with the low rates of incident reporting among maintenance technicians. The participant suggested increased feedback to maintenance technicians would help to improve reporting and expressed optimism that reporting culture would improve as employees become more familiar with and gain comfort with the ASAP program. Another participant hoped management would engage more to improve CRM between pilots and flight attendants, and between pilot-flight attendant unison and senior managers. The participant indicated that most of the issues presented at a safety

infoshare seminar earlier in the year, had yet to be addressed. Also, concerning flight attendants, a participant reiterated that although benefits of the ASAP program had been apparent, an additional major challenge they are still to overcome is the tendency of some flight attendants to keep working, serving customers during events of turbulence because “they think they’re going to get in trouble” despite of assurances from the management.

Two participants suggested that more work be done in the area of automation. Concerns related to automation included improper use, over-reliance, and loss of proficiency in hand-flying of aircraft. A concern related to the dispatch group was low experience due to high employee turnover rates.

4.8 Research Question Four

***Are demographic elements such as age, gender, and length of employment, significant variables of perception of safety climate at the subject airline*?**

Statistical procedures for this question were similar to that of questions one and two. To answer question four, the researcher used Kruskal-Wallis H nonparametric tests to determine whether the dependent variables under investigation were statistically different. The researcher used an alpha value of .05 to limit type I error to 5%. A Bonferroni adjustment was used where necessary to adjust the ρ value for more accurate results.

4.8.1 Results of age-group as a variable of safety climate

Results for testing age groups as independent variables of safety climate indicated statistically-significant differences in perceived *Management’s*

commitment to safety and perceived *Employee involvement in safety* (figure 11). Figure 12 shows the results of pairwise comparison among the age groups. For pair-wise comparison, age group was not a statistically significant factor in of Management's commitment to safety.

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Mgmt_Commit_Safety is the same across categories of Age Group.	Independent-Samples Kruskal-Wallis Test	.046	Reject the null hypothesis.
2	The distribution of Perceived_Employee_Involvement is the same across categories of Age Group.	Independent-Samples Kruskal-Wallis Test	.025	Reject the null hypothesis.
3	The distribution of Mgmt_Action is the same across categories of Age Group.	Independent-Samples Kruskal-Wallis Test	.111	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 11. Age group as a variable of safety culture

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
41 - 50-> 60	-1.265	14.450	-.088	.930	1.000
41 - 50-31 - 40	10.345	6.077	1.702	.089	.887
41 - 50-21 - 30	18.556	7.288	2.546	.011	.109
41 - 50-51 - 60	-21.583	7.480	-2.886	.004	.039

Figure 12. Age-group pairwise comparison – perceived employee participation in safety

4.8.2 Results of the assessment of the number of years of employment with company as a variable of safety climate

Number of years individuals had worked at a company appeared to influence participants' perception of *Management's commitment to safety* and *Management's actions* (figures 13, 14, and 15).

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Mgmt_Commit_Safety is the same across categories of Years with company.	Independent-Samples Kruskal-Wallis Test	.025	Reject the null hypothesis.
2	The distribution of Perceived_Employee_Involvement is the same across categories of Years with company.	Independent-Samples Kruskal-Wallis Test	.078	Retain the null hypothesis.
3	The distribution of Mgmt_Action is the same across categories of Years with company.	Independent-Samples Kruskal-Wallis Test	.008	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 13. Number of years of employment with airline

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
6 - 10-> 10	-3.379	6.559	-.515	.606	1.000
6 - 10-1 - 5	15.141	6.152	2.461	.014	.083
6 - 10-< 1	22.144	7.702	2.875	.004	.024

Figure 14. Management Action: Pair-wise comparison of categories of the number of years exmployees had worked with company

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
> 10-6 - 10	.552	6.543	.084	.933	1.000
> 10-1 - 5	10.595	7.296	1.452	.146	.879
> 10-< 1	21.202	8.637	2.455	.014	.085
6 - 10-1 - 5	10.042	6.137	1.636	.102	.611
6 - 10-< 1	20.650	7.683	2.688	.007	.043

Figure 15. Management's commitment to safety: Pair-wise comparison of categories of the number of years exmployees had worked with company.

4.8.3 Results of the number of years employee had worked at current job as a **variable** of safety climate

As shown in figure 16, there were no statistically-significant scores in the Kruskal-Wallis Test - all pair-wise comparisons, to suggest age category, in years, that survey participants had worked at their current jobs, was a variable in perceptions of safety culture at the subject airline.

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Mgmt_Commit_Safety is the same across categories of Years at work.	Independent-Samples Kruskal-Wallis Test	.703	Retain the null hypothesis.
2	The distribution of Perceived_Employee_Involvement is the same across categories of Years at work.	Independent-Samples Kruskal-Wallis Test	.871	Retain the null hypothesis.
3	The distribution of Mgmt_Action is the same across categories of Years at work.	Independent-Samples Kruskal-Wallis Test	.448	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 16. Number of years woked at current job

4.8.4 Results of gender as a variable of safety climate

Testing for gender as a significant variable of Safety culture rejected the null hypothesis, indicating gender was as a statistically-significant factor of *Management's commitment to safety* at ρ = .025 (figure 17), with females having a higher perception compared to male (figure 18).

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Mgmt_Commit_Safety is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.025	Reject the null hypothesis.

Figure 17. Age group as variable of safety culture

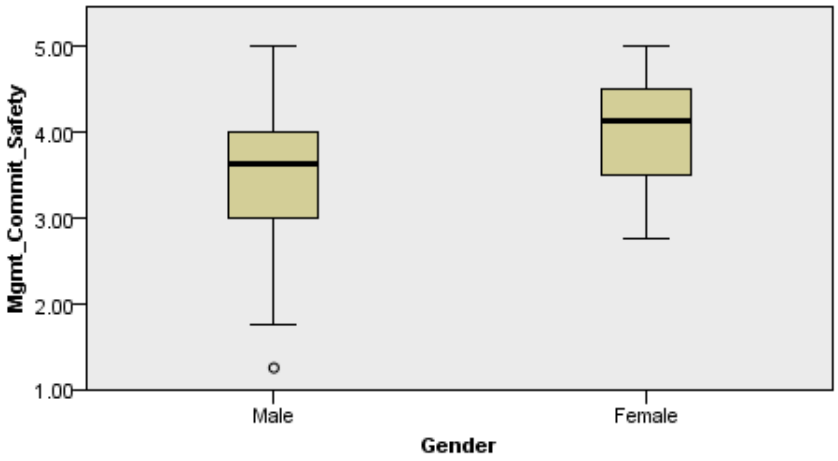

Figure 18. Age pairwise comparison

4.8.5 Results of perception towards management

As shown by figure 19, data did not indicate statistical significance across the groups on the groups' view of management's commitment towards enhancing safety at the subject airline.

Null Hypothesis	Test	Sig.	Decision
The distribution of Perception towards Management is the same across categories of Job.	Independent-Samples Kruskal-Wallis Test	.171	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 19. Perception of management's commitment to safety

4.8.6 Results of groups' average safety score

The survey asked participants to provide a score, of between 1 and 10, 10 being the highest, of their rating of safety culture at the subject airline. The mean score among all participants was 6.5. Tests indicated data met assumptions for

homogeneity (F = .52, ρ = .71), but not normality. With a ρ value of .323 (figure 20), the Kruskal-Wallis result indicates there was no significant difference between employee groups regarding perception of the average safety score at the subject airline.

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Average safety score is the same across categories of Job Category.	Independent-Samples Kruskal-Wallis Test	.323	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 20. Job category as variable for safety score

4.8.7 Results of employee perception of management's commitment to safety

Regarding responses on employee view of management's commitment to safety at the subject airline, data (figure 21) indicates there was job category was not a significant factor of employee perception of management's commitment to safety at the subject airline.

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of employee perception of Mgmt. is the same across categories of Job.	Independent-Samples Kruskal-Wallis Test	.114	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 21. Employee perception of management's commitment to safety

4.9 Summary of Findings

The purpose of the current study was to assess employee perception of the safety culture, safety climate, and four pillars of SMS at a regional airline. Front line employee groups pilots, maintenance technicians, flight attendants,

dispatchers, and managers participated in this study. The specific objectives of the current study were to answer the following research questions:

1. *What are employee perceptions of the safety climate at the subject airline among and across the target study groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline?*
2. *What are employee perceptions of the four SMS pillars at the subject airline, among and across the target study groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline?*
3. *What are employee perceptions of the safety culture at the subject airline among and across the target study groups: pilots, maintenance technicians, dispatchers, flight attendants, and the management of the subject airline?*
4. *Are demographic elements such as age, gender, and length of employment, significant variables of perception of safety climate and/or safety culture at the subject airline*?

The current study used a mixed method and cross-sessional design to investigate the research questions. The researcher collected data through interview, focus group, and online survey. The focus group session intended to gain further understanding of responses from the online survey and the interview segments of the current. Results indicate flight attendants perceived Just and Learning cultures significantly higher than maintenance technicians did. Similarly,

data suggests flight attendants had a higher perception of all the pillars of SMS than maintenance technicians did. Result of the current study failed to dispute the null hypothesis that there was no difference among all employees concerning their perception of the five elements of safety culture.

Regarding safety culture, data indicates a significant prominence and value of the ASAP program. Employee responses suggest data reporting may be correlated to a number of variables such as perceived risk, ability for a third party to be knowledgeable about an incident in question, desire to protect oneself from litigation, perceived value, and level of just/unjust culture.

CHAPTER 5. DISCUSSION AND CONCLUSION

Chapter four provided the analysis and results of the study. This chapter will provide a summary of the current study. It will discuss the results of the present study, suggest possible implications of current study, address the study's limitations, and offer recommendations. This chapter will end with conclusions to the present study.

5.1 Summary of Findings

The purpose of the present study was to assess the safety culture and safety climate at a regional airline. The target population was pilots, maintenance technicians, flight attendants, dispatchers, and managers of the subject airline. The study also evaluated participants' perception of the subject airline's SMS. This chapter provides the results and analysis of the mixed method approach that utilized three data capturing techniques in the current study: interview, focus group activity, and online survey. The researcher applied appropriate data analysis techniques including thematic approach within inductive reasoning and inferential statistics to answer the research questions.

The first research question investigated whether there were variations in employee perception of the safety climate among and between studied groups, at the subject airline. Data from participants' responses from the quantitative

segment of the online safety climate survey was used to investigate this question. Results suggest that flight attendants regarded Management's commitment to safety higher than maintenance technicians did, at the subject airline. Data did not indicate a significant difference among all participants in this area.

The second research question investigated whether there were variations in employee perception of the four pillars of SMS among and between studied groups at the subject airline. The researcher used participants' responses from the quantitative segment of the online survey to investigate this question. Results indicate a significant difference among participants regarding the four pillars of SMS. Results also indicate flight attendants' perception of all the four pillars of SMS was significantly positive compared to that of maintenance technicians.

The third research question investigated whether there were variations in employee perception of the safety culture among and between studied groups, at the subject airline. The researcher used all three data capturing techniques: interview, open-ended segment of the online safety climate survey, and the focus group activity, to answer this research question. Data from the three sources indicated the ASAP program was largely successful or promising at the subject airline. In addition to observations such as relatively positive reporting and just cultures among pilots and flight attendants; other notable observation by the data include, the new-hire training and annual retraining activities were critical to safety training; and the monthly safety newsletter and memos were identified as the most accessible safety publications. Elements unfavorable to safety, as indicated by the data, included management being out-of-touch with employees,

poor communication across the subject airline, a weak reporting culture among maintenance technicians, cases of some flight attendants not adhering to proper responses during turbulence events, and pilots' reluctance to using the fatigue management program.

The fourth research question investigated demographic variables as factors influencing perception of safety climate at the subject airline. The researcher of the current study used data from the online safety climate survey to investigate this question. Results indicated that the age, gender, and length of time an employee had worked with the subject airline were factors, which influenced the workers' perception of safety climate. Data did not support the hypothesis that the number of years an employee had worked at their current job was a factor affecting perception of safety climate. Equally, data did not show that job-group was a significant factor in employee perception of management's commitment to safety at the subject airline. Table 14 shows a summary of all study participants' top five overall perceptions, negative as well as positive responses, regarding safety culture and safety climate at the subject airline according to the researcher.

Table 14 *Aggregated Participants' Perceptions*

Positive perceptions	Negative perceptions
Safety progress & optimism	Management out of touch
ASAP- most successful safety program	Poor communication feedback
Pilot - safest group	Maint. Tech - least safe group
Safety training is effective	Safety sacrificed for productivity
Safety publications	Non-compliance culture

5.2 Discussion

SMS is a top-down comprehensive method of managing organizational safety (GAO, 2012; ICAO, 2009). The collection of the quantity and quality of data is increasingly becoming significant to safety (GAO, 2012), especially to efforts to shift the approach to safety towards a predictive approach, which is enshrined in SMS (FAA, 2015). The purpose of SMS is to reduce risks to acceptable levels (Ayres et al., 2009) and to attain a dynamic organizational safety culture that nurtures positive safety behavior such as safety reporting (Rose, 2006). FAA (2015) states that while the Safety risk Management and Safety assurance are the most important of the four SMS pillars, safety culture is a critical variable of success of any safety program. The proper understanding of safety culture by leaders in the aviation industry and by other aviation safety stakeholders has the potential to improve aviation operational safety (von Thaden, 2008). The current study assessed safety climate, culture, and employee perception of SMS at the subject airline, all vital elements of a robust operational safety.

Several results in the current study mirror results observed from other scholarly works. The current study suggests that employee incident reporting is motivated by positive and negative stimuli. Positive stimuli identified by the study included pilots' inherent pro-activeness to safety, a more active-hazard environment (as it regards to pilots and maintenance technicians, and just culture. Negative stimuli included the need to protect pilots' license, ambiguity in what constitutes an unsafe and reportable event (in the case among maintenance

technicians), an inherent low desire to report, and an environment of unjust or blame culture (also as indicated by data to be the case among some maintenance technicians). The stated outcomes of the current study mirror observation some observations by other researchers in related studies (Adjekum et al., 2015; Cooper, 2001; Cox & Cox, 1991; FAA, 2014; GAIN Working Group, 2004; and Hudson, 2001b.)

The seemingly overwhelming success of the ASAP program, particularly among flight attendants, may help explain why flight attendants seemed to perceive safety climate, safety culture, and Management's commitment to safety, more positively than maintenance technicians did. Researchers (Shappell & Wiegmann's, 2000; Tsay et a, 2014) have addressed the importance of the role of senior managers plays in the success of safety programs, including formulations of effective safety policies and safety promotion strategies. It is possible that flight attendants felt that the managers played a significant roles in what flight attendants portrayed as success with the ASAP program, including its effective promotion as well as adhering to the significant non-punitive aspect of the program. The two "important" practical applications (pilot-flight attendant improved CRM and turbulence-related safety improvements) indicated by respondents as resulting from the ASAP program, may have also give an impression of management's involvement in terms of feedback and other systematic support regarding flight attendants. This is in stark contrast to maintenance technicians, whom, as data indicates, the management was most out-of-touch with, in addition to being subjected to the most blame culture.

However, as there were no significant differences among all responses as a group in regards to safety climate, and that some elements of safety culture such as senior management being “out-of-touch” with employees, may underline common or systematic latent organizations negative aspects of safety. The difference between flight attendants and maintenance technicians in reference to just culture, learning culture, the four pillars of SMS, and perception of the general safety culture. Four out of five flight attendants who responded to the safety climate survey were female. Across all the three segments of the present study, flight attendants responded overwhelmingly positively regarding the ASAP program, including valuable feedback, just culture, and practical changes as a result. This is in line with previous research that suggests factors such as effective feedback, communication, and just cultures positively affect safer practices (Liou et al., 2008; Reason, 1998).

While participants suggested, regarding safety climate, that pilots were best at safety reporting, data suggests that flight attendants perception of safety culture was most contrasting with that of maintenance technicians, whose perception of the same was least positive. A possible explanation, as indicated by data from the current study, is that flight attendants’ positive responses could be influenced by the fairly new success the group had experienced with the ASAP safety program. In contrast, for example, the group pilot was perceived as safest and had had longer experiences with safety programs such as ASAP, except for the fatigue management program, but did not register statistically significant difference in perceptions of safety climate from any other group

studied. Additionally, as indicated by data, flight attendants also scored well in safety culture, but were more likely to report incidents purely for safety promotion and safety risk management reasons. Pilots, on the other hand, may have more reasons to report incidents, such as protection of their licenses or the ability of another department, such as air traffic control, to report the same incident. It can however argued that, regardless of the reasons for reporting the incidents, increased reporting is better than no or under-reporting. An element of interest, and of possible research interest, could be the quality of reporting based of the reason for reporting. Stolzer (2011) lists possible limitations of human reporting systems as non-reporting and partial or false reporting and suggests automatic data transmission system as a possible remedy to these limitations.

The study indicated no significant difference in perception of safety climate among job categories; perception of safety climate, given the number of years an employee had worked at employee's current job; safety rating, given the job type; and perception of management's commitment to safety, given the a job category. Possible reasons for these observations could be explained by a series of underlying similarities in qualitative responses among respondents, whether positive or negative. Positive underlying responses include a general perception that safety has improved much in 'recent times', a general positive outlook on safety at the subject airline, the role played by the safety team, and an overwhelming positive regard for the ASAP safety program. Negative similarities include the perception of the management as out of touch from front line employees; poor communication and or feedback between all employee

hierarchies; unjust culture; and perception of management's prioritization of productivity over safety.

Participants who had worked at the airline between, and including, six to 10 years appeared to perceive managers as more committed to safety, and that managers actions were more favorable to promoting safety, than participants two had worked at the airline for less than a year did. It is possible that participants who had worked at the organization longer were older, more experienced hence had a clearer understanding of work-related risks, and perceive risk differently than those how had worked at the company for less than a year. This observation can also be explained by the lack of sufficient evidence to suggest that the length of time an employee had worked at employee's current job, was a factor of perception of safety culture and safety climate, and that age was a factor of the same. Adjekum et al. (2015) suggests that age is factor or safety reporting possibly due to perception of reportable risk. However, it is interesting, that with the current study, regarding perceived employee involvement in safety, the difference is between adjacent age groups 41-50 and 51-60. It is possible that this observation is purely coincidental, related to statistically significant different responses based on job category such as maintenance and flight attendant, or yet, subject to other confounding factors otherwise not addressed in or by the current data.

5.3 Limitations

The current study experienced a number of limitations. The sample size for the online survey (n = 71) was lower than the researcher had anticipated (approximately n = 200). Equally, some sub-groups of the study, such as senior management, received low or zero representation on the survey segment of the current study. According to Newey and McFadden (1994), sample size can affect type I error. To limit the effect of a smaller sample size, the current study employed the Kruskal-Wallis nonparametric H test where applicable. While the smaller sample size also limits the generalizability of the current findings, the results provide valuable information to the researcher, the subject airline, aviation safety stakeholders, and other researchers.

A second limitation of the current study was the use of one focus group session. The researcher had originally designed to hold two focus group activities, one comprising front line employee, the other, the management team. Financial, operational, and organizational changes that took place in the subject airline within the period of the current study created a challenging environment to hold a frontline-employee focus group activity.

Participation from the group Dispatch was relatively low, which affected the assessment of the group in this study. Participation to the current study was anonymous and confidential. As such, the researcher was limited regarding follow-up efforts related to the study, such as member checking.

5.4 Recommendations

Data from the current investigation assessed the relevant research questions, but also raised new areas of potential interest.

5.4.1 Recommendations for Practice

Limitations of the current study restrict generalizability of the study findings. Nevertheless, the findings can still provide some insight into the dynamics of airline safety environment as well as important lessons. Based on the current study's findings, strategic planning in an organization's expansion, operationally or geographically, should include measures that ensure a sustained and efficient communication standard across all employee hierarchies, to a level that maintains a positive safety environment.

The current study indicated that just culture; perceived risk; and effective and timely feedback regarding incidents reported; were among the vital factors to reporting culture. These values and elements should be constantly nurtured. Nevertheless, where these elements are in play, effective employee education as it pertains to new and existing safety reporting programs, as well as appropriate motivation and interventions to use these programs, are vital measures to promote an effective safety reporting culture. A case in point was the role that just culture, employee education, and valuable feedback appeared to have in rapidly building trust and acceptance of the ASAP program among flight attendants. New programs need constant reevaluation and necessary changes effected, as appears to be the case for pilots' experience pertaining to the fatigue management program.

As safety culture and safety climate are dynamic (Taylor, 2012), as well as due to limitations associated with qualitative and cross-sectional studies (Creswell, 2009) safety culture and safety climate studies should be conducted as frequently as practical. Specific issue suggested by participants, particularly those that appear critical and not substantiated by the researcher or participants such as cited routine violations, be investigated further, accordingly, by the study subject organizations.

5.4.2 Recommendation for future Research

The researcher of the current study recommends the following items for future research. The current study is cross-sectional in design. One of the limitations of a cross-sectional study is that it provides only a snapshot of a situation in time (Creswell, 2009). A longitudinal design study would allow for investigating trends and would provide relevant consistent mitigations that may be particularly important and in tandem with the dynamic nature of organizational culture.

The researcher of the current study recommends future work to include at least three focus groups that target each of the group segments, frontline employees, middle-level managers, and executive/senior managers. This approach would promote equal representation of all hierarchies and may gather comprehensive data related to the study for more accurate analyses.

While the present study identified many variables of safety climate and safety culture, the researcher recommends further research in mitigating

psychological variables. An example of a positive psychological variable of safety reporting identified by the current study was the inherent desire by some participants to provide information useful to other employees and the organization. However, of particular concern to the researcher of the current study were two behaviors. The first pertains to the fear, among some flight attendants, of receiving negative feedback from passengers or “getting in trouble”, which prompted them to keep serving passengers through occurrences of turbulence, this, despite the assurance of support from the subject airline’s management. Similarly, some responses suggested that maintenance technicians, among other motivation of a negative safety culture and climate, was the strong sense of owing the passenger a timely flight.

5.5 Conclusions

Safety is vital in the aviation industry. Airlines are expected to implement SMS by the year 2018 (FAA, 2015b). The success of the SMS, a comprehensive safety management program that allows for a positive safety standing in an organization (GAO, 2012; ICAO, 2009) is highly reliant on the prevailing organizational safety environment (FAA, 2015). Safety climate allows for the capture of employee “…attitudes, opinions and feelings towards safety, and its management within the organization” (HSE, 2005, p. 16). Knowledge about employee perception of SMS, safety culture, and safety climate, is essential in establishing a sustained safe operational environment. The current study investigated these three elements at the regional airline.

Research finding suggests no significant differences among respondents regarding safety culture, but that, flight attendants perceive Just and Learning cultures more positively that maintenance technicians, when the studied groups were compared, as well as management's commitment to safety. Additionally, time participants had worked at the subject airline appeared to be a variable in perception of safety climate.

The findings also suggests that employees perceived the ASAP safety program very positively and had an optimistic view of safety at the subject airline. Limitations of this study included small sample sizes for survey participants and the inability to conduct a frontline-employee focus group activity.

Among the researcher's recommendations for application and for future research included better promotion and evaluation of safety programs; investigation of psychological variables of safety behavior; and suggested carrying out longitudinal studies. Additionally, the researcher recommended further investigation into all allegations of routine violations identified in such studies by subject organizations.

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APPENDICES

Appendix A Participant Information Sheet

For IRB Use Only

RESEARCH PARTICIPANT INFORMATION SHEET

Perception of Safety Culture at a Regional Airline

Dr. Richard Fanjoy - Principal Investigator

Mr. Micah Walala – Co-investigator

School of Aviation and Transportation Technology

Purdue University

Your opinion about the safety climate at “deleted” is important in the continual improvement of safety in the aviation industry. The purpose of this study is to attempt to assess the perception of front line operational personnel such as pilots, dispatch, and maintenance personnel, as well as management’s opinion of the status of the safety culture at a regional airline. Understanding safety perceptions will assist regional airlines in making continuous safety improvements to all aspects of its operations. My name is Micah Walala, a student from Purdue University in the School of Aviation and Transportation Technology, working closely with Dr. Richard Fanjoy, the Principal Investigator. You are eligible to

participate in this study because you are an employee of “deleted” [subject airline] or its subsidiary, and are at least 18 years old.

Since answers are to remain anonymous, PLEASE DO NOT PUT YOUR NAME ON THIS SURVEY. Results will be reported for the group of respondents as a whole to further ensure your anonymity. Furthermore, only the investigators will have access to the survey data. “Deleted” [subject airline] will be furnished with the final report that will not contain any personal identifiable data.

If you decide to participate in this study, you will take part in one, two, or three of the following study phases: survey, interview, and focus group activities. The questions in all three phases are designed to determine how you perceive the safety culture in your organization.

Survey: - You are asked to answer a short questionnaire of 20 questions with five point Likert-scale about your perception of aviation safety culture in your organization. The survey includes one open-ended essay style question. The survey will take approximately 10 minutes, and will be conducted on-line with a title ‘Safety Culture Survey’. The survey also asks you to identify some of your demographic information such as age and length of time you have worked at your current position.

Interview: - You are asked a set of questions about your perception of safety culture in your organization. The interview is designed to last for approximately 30 minutes. With your permission, the interview will be audio recorded. The recording is only for purpose of the research. Only Dr. Fanjoy and I will listen to the recording.

Focus group activity: - A set of questions and topic will be introduced for your opinion and discussion. With your permission, the session will be audio recorded. The recording is only for purpose of the research. Only Dr. Fanjoy and I will listen to the recording. The focus group session will last for approximately 30 minutes.

Risks are minimal for involvement in this study. However, you may feel emotionally uneasy when asked to make judgments based on your perception of some safety issues affecting aviation safety at your organization. You may omit questions that you feel uncomfortable to answer.

Your participation in this study is voluntary. Your may choose not to participate or stop participating at any time without penalty or loss of benefits to which you are otherwise entitled. Your opinions and comments are confidential and will be aggregated in the analysis.

If you will have any questions, comments, or concerns about this research project, feel free to contact Dr. Fanjoy at [redacted]@purdue.edu, 765 494 7764 or

Mr. Walala at [redacted]@purdue.edu. You may also contact Purdue's Human Research Protection Program at 767-494-5942, irb@purdue.edu, or write to:

Human Research Protection Program - Purdue University
Ernest C. Young Hall, Room 1032
155 S. Grant St.,
West Lafayette, IN 47907-2114

Appendix B Intranet and Electronic Recruitment Statement

Safety Culture Study

Your opinion about the safety climate at “deleted” [subject airline] is important in the continual improvement of safety in the aviation industry. My name is Micah Walala, a graduate researcher working closely with Dr. Richard Fanjoy, a faculty member at Purdue University in the School of Aviation and Transportation Technology, invite you to participate in an anonymous survey about perceptions of the safety culture at “deleted” [subject airline]. Understanding safety perceptions will assist “deleted” [subject airline] in making continuous improvements in safety to all aspects of its operations. You must be 18 years or older to participate. The survey is voluntary. You may stop participating at any time without consequence.

Since answers are to remain anonymous, PLEASE DO NOT PUT YOUR NAME ON THIS SURVEY. Results will be reported for the group of respondents as a whole to further ensure your anonymity. To further protect your identity, only the investigators will have access to the survey data. “deleted” [subject airline] will be furnished with the final report that will not contain any personal identifiable information.

The survey will take approximately 10 minutes. Please answer questions to your comfort level. To participate in the survey, click on the link below. Your consent is implied by clicking on the link, and participating in the study.

If you have any questions or concerns, feel free to contact Dr. Fanjoy at [redacted]edu, 765 [redacted] or Mr. Walala at mwalala@purdue.edu, 765 [redacted]

Again, we very much appreciate your assistance in this research effort.

<Insert Qualtrics link>

Appendix C Focus Group Script

Hello and welcome to this focus group session intended to assess the safety climate at "deleted" [subject airline]. My name is Micah Walala, a graduate researcher working closely with Dr. Richard Fanjoy, a faculty member at Purdue University in the School of Aviation and Transportation Technology. I will conduct the discussion and take notes. Your opinion of safety climate at "deleted" [subject airline] is important to improving aviation operational safety. I invited you all to share and discuss your perceptions of safety at this organization. I will ask you several open questions. Your personal opinions and view are very important to the study as well as to the continuous improvement of safety in the aviation industry.

There are no right or wrong answers. Please feel welcome to express yourself freely during the discussion. This conversation will be digitally audio recorded. The recording is only for purpose of the research. Only Dr. Fanjoy and I will listen to the recording. Your opinions and comments are confidential and will be aggregated in the analysis. No names or personal information will be used in the report. However, due to the context of group research, researchers cannot guarantee confidentiality as investigators cannot control what individuals say outside the research context. Participation is also voluntary. You may stop participating in the discussion at any time without consequence.

The discussion will last for about one hour. I ask you to please switch off your mobile phones. Please give everyone the chance to express his or her opinion during the conversation. You can address each other when expressing your opinion. I am only here

to assist in the discussion. Is everything clear about the course of the focus group discussion?

If you will have any questions or concerns later, feel free to contact me at mwalala@purdue.edu, 765 [redacted] or Dr. Fanjoy at [redacted] edu. 765 [redacted]

Appendix D Semi-Structured Interview Questions

Safety Culture and Safety Climate Semi-structured Interview Questions.

You identify yourself as: Front-line employee__ Supervisor or Middle-level manager__ Senior Manager__

1. How long have you been with “deleted” [subject airline] and what are your roles and responsibilities?
2. What aspects of the “deleted”’s [subject airline] safety program are you familiar with?
3. Do you have interaction with the “deleted” [subject airline] safety personnel?
4.
    a. How is safety emphasized in your work area with the employees you supervise? (for managers only)
    b. How is safety emphasized in your work area? (for front line employees only)
5.
    a. Is information about “deleted”’s [subject airline] safety programs available to you and if so, how is it disseminated to your employees? (for managers only)
    b. Is information on the “deleted” [subject airline] safety programs available to your front-line employees and if so, how is it disseminated to them. (for front line employees only)
6. On a scale of 1 to 5, 5 being the highest, what is your general opinion of the safety climate at this organization?
7. What areas of the organization do you feel are the strongest from a safety standpoint?
8. What areas of the organization do you feel need to further emphasize safety?
9. What are your recommendations, if any, for improving safety at “deleted” [subject airline]?
10. Do you have any further comments or recommendations?

Appendix E Study Consent Form

For IRB Use Only

RESEARCH PARTICIPANT CONSENT FORM

Perception of Safety Culture at a Regional Airline

Dr. Richard Fanjoy - Principal Investigator

Mr. Micah Walala – Co-investigator

School of Aviation and Transportation Technology

Purdue University

“deleted” [subject airline] values, and is interested in your opinion concerning its safety culture. The purpose of this study is to attempt to assess the perception of front line operational personnel such as pilots, dispatch, and maintenance personnel, as well as management’s opinion of the status of the safety culture at “deleted” [subject airline]. Understanding safety perceptions will assist “deleted” [subject airline] in making continuous improvements in safety to all aspects of its operations. My name is Micah Walala, a student from Purdue University in the School of Aviation and Transportation Technology, working closely with Dr. Richard Fanjoy, the Principal Investigator. You are eligible to participate in this

study because you are an employee of “deleted” [subject airline] or its affiliate, and are at least 18 years old.

If you decide to participate in this study, you will take part in one, two, or three of the following study phases: survey, interview, and focus group activities. The questions in all three phases are designed to determine how you perceive the safety culture in your organization.

Survey: - You are asked to answer a short questionnaire of 20 questions with five point Likert-scale about your perception of aviation safety culture in your organization. The survey includes one open-ended essay style question. The survey will take approximately 10 minutes, and will be conducted on-line with a title ‘Safety Culture Survey’. The survey also asks you to identify some of your demographic information such as age and length of time you have worked at your current position.

Interview: - You are asked a set of questions about your perception of safety culture in your organization. The interview is designed to last for approximately 30 minutes. With your permission, the interview will be audio recorded. The recording is only for purpose of the research. Only Dr. Fanjoy and I will listen to the recording.

Focus group activity: - A set of questions and topic will be introduced for your opinion and discussion. With your permission, the session will be audio recorded. The recording is only for purpose of the research. Only Dr. Fanjoy and I will listen to the recording. The focus group session will last for approximately 30 minutes.

Risks are minimal for involvement in this study. However, you may feel emotionally uneasy when asked to make judgments based on your perception of some safety issues affecting aviation safety at your organization. You may omit questions that you feel uncomfortable to answer. Although we do not expect any harm to come upon any participants due to electronic malfunction of the computer during the survey session, it is possible though extremely rare and uncommon

Your participation in this study is completely voluntary. Your may choose not to participate or stop participating at any time without penalty or loss of benefits to which you are otherwise entitled. Your opinions and comments are confidential and will be aggregated in the analysis.

If you will have any questions, comments, or concerns about this research project, feel free to contact Dr. Fanjoy at [redacted].edu, 765 [redacted] or Mr. Walala at [redacted]@purdue.edu. You may also contact Purdue's Human Research Protection Program at 767-494-5942, irb@purdue.edu, or write to:

Human Research Protection Program - Purdue University

Ernest C. Young Hall, Room 1032
155 S. Grant St.,
West Lafayette, IN 47907-2114

Documentation of Informed Consent

I have had the opportunity to read this consent form and have the research study explained. I have had the opportunity to ask questions about the research study, and my questions have been answered. I am prepared to participate in the research study described above. I will be offered a copy of this consent form after I sign it.

_____
_____
Participant's Signature
Date

_____
Participant's Name

_____
_____
Researcher's Signature
Date

Appendix F Focus Group Questions

Assessment of Safety Culture Perceptions at a Regional Airline

Focus Group Questions/Script

INTRODUCTION

Thank you for taking time out of your valuable schedule to participate in this focus group session. My name is Micah Walala. I'm a graduate student from Purdue University. I am working on my dissertation research, in which I am trying to assess perceptions of the safety climate and safety culture at "deleted" [subject company]. This is the last of a three-segment study. I have gathered and analyzed responses from online surveys and interviews. This meeting is about generating a discussion to educate my perceptions gathered so far from the two completed stages of the study. Please feel free to share your views and opinions.

GENERAL PERCEPTION OF WORK ENVIRONMENT

First, I would like to know a little more about your work areas.

1. To get started, what do you find most challenging about your work, and how do those challenges influence safety culture?

SAFETY REPORTING AND JUST CULTURE

Safety reporting; the aviation industry is increasingly relying on incident reporting to improve aviation safety.

2. What do you consider as the most effective safety programs, and why?
3. Data appears to indicate safety reporting has been steady among pilots, increasingly picking up among flight attendants, and still very low among maintenance technicians? What do you think accounts for these differences?

FEEDBACK

Feedback from incidents can be very helpful in preventing future accidents

4. Opinions regarding receiving feedback from incidents from programs such as ASAP, Incident Reporting, Safety hotline, and Ghost rider programs varied greatly among participants. Why do you think that is the case?

LEARNING CULTURE

A learning culture organization is characterized by two elements, an organization's ability to lean about its safety concerns, and its ability to implement necessary changes.

5. There seemed to be extreme conflicting views regarding the company's commitment to implant safety changes, what have been your personal experiences?

MANAGEMENT'S ROLE IS SAFETY

Now, let us discuss management's role in safety.

6. Responses from participants suggest that senior managers are largely out of touch from front-line employees and the safety department. If so, what safety implications are of concern?

7. How would you describe the relationship between management and front-line employees?

CRM

Let us talk about organizations. The nature of relationships between departments in an organization can influence prevailing safety standing.

8. How would you describe the relationship between employees of the various divisions in the company, and the impact of those relationships to safety?

Fatigue Management Program

The fatigue management program is intended to improve operational safety.

9. What are some of the challenges of the fatigue management program and how are both pilots and management coping with these challenges?

SUMMARY & CLOSING

All right, just three more questions.

10. What are the things you are most proud regarding safety culture at “deleted” [subject airline]?
11. What keeps you awake at night, in regard to safety?
12. Are there any other general comments regarding safety that you would like to share?

Thank you all for your time and for sharing valuable information. This is the last of a 3-segment study intended to assess the safety climate and safety culture at “deleted” [subject airline]. The final aggregated result will be available to the company for further safety considerations.

.

Appendix G Research Exempt Request Application

RESEARCH EXEMPTION REQUEST – CATEGORY 2 or 3

Purdue University – Institutional Review Board

INSTRUCTIONS

Failure to follow these instructions may result in the submission being returned to the principal investigator.

1. Use this form to request an exemption under Title 45 CFR §46.101(b)(2) or (3).
2. Use lay language and spell out acronyms. Do not cut and paste from or refer to grant or abstract.
3. Study activities may not be implemented until the investigator receives final written IRB notification the exemption has been granted.
4. In order to qualify for either of these exemptions, the study must fall into one of the following categories. Additionally you may wish to consult the decision chart for these categories.
5. Research involving **PRISONERS*** or other incarcerated individuals (or their existing data and/or specimens) do not qualify for exemption.

Category 2 involves **ONLY** the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:

- information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and
- any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Category 3 involves the use of **ONLY** the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior that is not exempt under category 2 if:

- the human subjects are elected or appointed public officials or candidates for public office; or
- federal statue(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

* **PRISONER** – means any individual involuntarily confined or detained in a penal institution. The term is intended to encompass individuals sentenced to such an institution under a criminal or civil statute, individuals detained in other facilities by virtue of statutes or commitment procedures which provide alternatives to criminal prosecution or incarceration in a penal institution, and individuals detained pending arraignment, trial, or sentencing [45 CFR 46.303(c)].

INVESTIGATOR INFORMATION

HAVE QUESTIONS about this section?

Principal Investigator Eligibility policy
Your Role and Education Requirements guidance

1. Principal Investigator contact information:

Name and Title	Department	Campus Address	Phone	Email	CITI Training Complete? Y/N
Dr. Richard O. Fanjoy	Aviation Technology	1401 Aviation Dr.	765[redacted]	[redacted]@purdue.edu	Y

2. Co-Investigators and/or Key Personnel contact information:

Name and Title	Department/ Institution	Phone	Email	Directly Interacting with Subjects? Y/N	CITI Training Complete? Y/N
Micah Walala	Aviation Technology	[redacted]	[redacted]@purdue.edu	Y	Y

3. Consultant(s) contact information:

Name and Title	University/ Institution	Phone	Email	Directly Interacting with Subjects or Accessing Identifiable Information? Y/N

CONFLICT OF INTEREST

4. Do the investigators or personnel have a significant financial interest in this study?

☒ NO - If no, skip to question 6.
☐ YES - If yes, proceed to question 5.

5. Has a Significant Financial Interest Disclosure Form been filed?

☐ NO - If no, refer to Financial Conflict of Interest: Policy and Procedures.
☐ YES - If yes, proceed to question 6 below.

6. Do the investigators or personnel have any other known conflict of interest in this study?

☒ NO
☐ YES - If yes, please explain the conflict: _____

STUDY INFORMATION

7. Study Title: PERCEPTIONS OF SAFETY CULTURE AT A REGIONAL AIRLINE

8. Funding Source: Select all that apply:

☐ Sponsor-External Funds (Includes PRF, Kinley Trust and McCoy awards)
Identify the Sponsor and grant/award number: _____
☐ Departmental Funding: _____

☒ Other Self-Funded: Movement to and from subject company's #### center

9. Anticipated Duration of Study: Please indicate when this project will end 8-31-2016

10. Identify the expected age range(s) of participants to be included or targeted for this research and for which there is a reasonable expectation of enrollment into this research study.
Check all that apply:
☐ under 18 years of age
☒ 18-64
☒ 65 and older

11. Identify where the research data collection will occur.
Check all that apply:
☐ Purdue University, please identify campus:
☐ Elementary/Secondary School(s), please identify school(s):
☐ Community Center, please identify:
☐ Other University/College, please identify:
☐ International Population(s) studied in their home country or within the US. Please identify the population(s) and the location of the data collection below. **ALSO** Section L, International Research, of the non-exempt research application must be completed and submitted with this exemption request in addition to the required supplemental materials:
☒ Internet
☐ Subject's Home
☒ Other location(s), please identify: Airline's operational location (####)

12. Will the study collect data from focus group(s)?
☐ NO
☒ YES

13. Will elected or appointed public officials, or candidates for public office, participate in the research?
☒ NO
☐ YES – Identify which public office(s) participants either hold or are candidates for:

14. Will prisoners and/or individuals involved in court-ordered programs or community corrections (or their data and/or specimens) be participants in the research?
☒ NO
☐ YES - If yes, the research does not qualify for exemption. Please complete and submit a Non-Exempt Research Application for review by the convened board (aka full review).

15. Will the research involve surveys or interview procedures with participants under age 18?
☒ NO
☐ YES - If yes, the research does not qualify for exemption. Please complete and submit a Non-Exempt Research Application for review.

16. Will the research involve observations of participant behavior and the investigators will interact with those participants?
☒ NO
☐ YES - If yes and the participants will be **under age 18**, the research does not qualify for exemption. Please complete and submit a Non-Exempt Research Application for review.

STUDY PROCEDURES

17. Briefly state your research question using non-technical *lay language* that can be readily understood by someone outside the discipline.

- What are the subject airline's employees perceptions and attitudes of the company's safety policies, practices, and procedures?
- How do these perceptions compare among the different work groups and demographics in the company?

18. Will survey procedures be used? Survey procedures CANNOT be used with children under 18 years of age.

☒ YES - Identify all surveys to be used **AND** submit them with this exemption request. (attached)
☐ NO

19. Will interview procedures be used? Interview procedures CANNOT be used with children under 18 years of age.

☒ YES – Describe the interviews **AND** submit all interview questions/scripts with this exemption request. _____
☐ NO

20. Will educational tests be conducted?

☐ YES - Check the test categories to be used below and identify each test in the text box below. If the study tests do not fit into the categories below, the study does **NOT** qualify for this exemption.
☒ NO - Skip to question 21.

- ☐ Cognitive – Identify test(s) below and submit with exemption request.
- ☐ Diagnostic – Identify test(s) below and submit with exemption request.
- ☐ Aptitude – Identify test(s) below and submit with exemption request.
- ☐ Achievement – Identify test(s) below and submit with exemption request.

Identify the tests to be used: _____

21. Will observations of public behavior be made? Observational research involving sensitive aspects of a participants' behavior, or in settings where subjects have a reasonable expectation of privacy, does **NOT** qualify for exemption.

☐ YES – Describe the observations **AND** identify the venue(s) where data will be collected.

_____

☒ NO

22. Will audio, visual or image (e.g., photograph) recordings be made?

☒ YES - Indicate below the type of recordings to be used. Check all that apply.
☐ NO - Skip to question 23.

- ☒ Audio recordings
- ☐ Video recordings
- ☐ Image recordings/photographs

All phases of the study will request participants not to provide or record names, education level, and ethnicity, among other data that may influence participant expectations of privacy. The demographic section of the questionnaire requests participants to provide data such as gender, age, and length of time employed at the organization. These data will facilitate the investigation of the research questions which are simplified as:

- What are the subject airline's employees perceptions and attitudes of the company's safety policies, practices, and procedures?
- How do these perceptions compare among the different work groups and demographics in the company?

The study will investigate demographic data as an independent variable of employee perception of the organization's safety climate, the response variable. Additionally, the study will investigate demographic data as an independent variable of safety reporting behavior, another response variable. The need to investigate demographic data such as seniority and experience stems from relevant literature review.

Adequate measures will be in place to ensure privacy and anonymity during and after the study. Demographic results will be reported for the group of respondents as a whole. For instance, all *top-level* management opinion of the organization's safety climate will be aggregated and reported for the group. Their responses to *safety behavior* will likewise be grouped and reported collectively. A similar approach will be observed while investigating other variables such as gender, age group, and length of time a participant has worked at the organization. With over 10,000 employees under one parent organization and two subsidiaries, it would be difficult to individually identify a participant.

Additionally, researchers will not triangulate demographic data in such a way that would make it easier to identify a participant. For instance, age, rank, operational city, and work-group will not be triangulated against a response variable, which would potentially make it easier to identify a participant. Any other identifiable data intermittently captured during the course of the study will be redacted during data analysis process.

To assist with accurate recording of participant responses, interviews and focus group sessions may be recorded on an audio recording device. Any identifiable data intermittently captured by the recordings will not be transcribed. Results will be presented without identifiable information. All recordings will be deleted after audio data has been successfully transcribed. Furthermore, to protect minors, the study requests only those who are at least 18 years old to participate.

Concerning focus group activities, the study investigators will inform participants that due to the context of group research, researchers cannot guarantee confidentiality as investigators cannot control what individuals say outside the research context.

Additional measures to ensure participants' confidentiality during and after the study include processing data and transcribing recordings without names, properly disposing data, and destroying or deleting data and documents. Other potential identifiable information such as departments or names will be coded if need be. Computerized records will also be assigned

security codes. All identifiable data intermittently captured during the course of the study will be redacted during data analysis process. #### [the airline] will have access to report that will not contain any identifiable data.

26. Indicate below how the investigator will receive/record the research data.

☒ No identifiable data received – **Skip to question 30.**
☐ Coded data received; investigators have NO access to code key – **Skip to question 30.**
☐ Coded data will be received; investigators have access to code key
☒ Identifiable data received/recorded by investigators

27. Describe what provisions, if any, will be taken to maintain confidentiality of identifiable data (e.g., surveys, audio, video, etc.). Please state where the data will be stored, how long it will be kept and who will access it.

Prior to engaging in any phase of the study, participants will be informed of the purpose of the study, privacy expectations, anonymity of the study, and that participation in the study is completely voluntary. Additionally, all phases of the study will request participants not to provide any identifiable data. Respondents will also be informed that results will be reported for the group of respondents as a whole. Principal investigator and co-investigator's contact information will be available to participants, to enable participants to seek further clarifications about the study. Only the principal investigator and the co-investigator will access captured data. Responses to the questionnaire will be captured and stored on a secure Qualtrics® server. Data on Qualtrics® will be accessed, downloaded, and processed using password protected computer accounts. Data might also be stored and accessed on a password protected flash drive. All identifiable data intermittently captured during the course of the study will be redacted during data analysis process. Audio recordings will be transcribed while excluding any identifiable data. Audio recordings will be deleted and physically destroyed after data has been transcribed. To protect minors, the study requests only those who are at least 18 years old to participate. The study will not capture some parameters such as ethnicity and educational level that may influence participants' expectations of privacy. Concerning focus group activities, the study investigators will inform participants that due to the context of group research, researchers cannot guarantee confidentiality as investigators cannot control what individuals say outside the research context

28. Will identifiable data and/or coded (linked) data be made available to anyone other than the research team?

☒ NO
☐ YES - If yes, please identify to whom data will be made available and the reason for the disclosure. _____

29. Indicate below what will happen to the identifiable data at the end of the study.

☒ Identifiers permanently removed from the data and destroyed
☒ Recordings transcribed without identifiers and destroyed
☐ Identifiable or coded (that can be linked) data are retained

RECRUITMENT

30. Identify below all recruitment procedures and materials used in the study. Submit a copy of all materials or text summaries for phone calls and media advertisements.

- ☐ Face-to-face contact
- ☐ Flyer(s)
- ☐ Letter (s)
- ☐ Phone
- ☒ Email(s)
- ☐ Media Advertisement(s) – Indicate below the media outlet used
  - ☐ newspaper
  - ☐ radio
  - ☐ television
  - ☒ social media site(s) – identify media site(s) below:

The study comprises three phases of research, survey, interview, and focus group activities, in the respective order. In the first phase of the research, participants will be recruited by a recruitment statement on the subject company's intranet and electronic newsletters. The recruitment statement will introduce the study, its purpose, the voluntary nature of the participation, and privacy considerations. The entire study sample will be requested and expected to participate in this first phase of the study. A copy of the questionnaire questions are attached to this application. A Qualtrics® link containing the study questionnaire will direct participants to the questionnaire at the end of the recruitment statements.

The second (structured interview) and third (focus group activities) phases of the research will employ a purposeful sampling technique. This technique calls for reaching out to users who are richly knowledgeable on the subject matter and/or have experience, are willing, as well as able to effectively articulate their resourcefulness. Only a few representatives from each of the targeted study groups will be expected to participate in the last two stages; two in the *top-management* group, two in the *middle-management group*, and two is *immediate supervisor*. Additionally, the groups *dispatch*, *pilot*, *cabin crew*, and *maintenance technicians* will each be represented by two participants. A company liaison will facilitate the sampling technique process. To deter undue influence/cohesion of participants, the organization's liaison will forward recruiting email from investigators to the purposefully sampled potential participants. The recruitment email will have investigators contact information, and will request potential participants to communicate directly to investigators with a decision on whether to participate in the study as well as for inquiries related to the study. The organization's liaison will forward the recruitment email from the investigators to multiple potential participants of each targeted group. Where more than two respondents per a targeted study group will respond positively, willingness to participate, investigators will randomize the final selection of participants.

It is possible for a participant to be involved in all the three phases of the study. However, the study has no interest in, is not designed to, and may not have the ability or mechanism

to track individual participant's involvement across the study phases. The semi-structured questions for the interview phase of the study are attached to this application. Questions for the focus group activities phase of study will be derived from results of the first two phases of the study. The researchers will register an IRB amendment for the focus group activity questions.

31. Briefly describe how potential participants will be contacted and identify **who** will contact them.

In the first phase of the research, the questionnaire study, participants will be recruited by a recruitment statement on the subject company's intranet and electronic newsletters. The recruitment statement will introduce the study, it purpose, the voluntary nature of participation and well as privacy considerations. All participants will be expected to participate in this first phase of the study. A copy of the questionnaire questions are attached to this application. A Qualtrics® link containing the study questionnaire will direct participants to the questionnaire at the end of the recruitment statement.

The second (structured interview) and third (focus group activities) phases of the research will employ a purposeful sampling technique. This technique calls for reaching out to users who are well versed on the subject matter and/or have valuable experience, are willing, as well as are able to effectively articulate their resourcefulness. Only a few representatives from each of the targeted study groups will be expected to participate in the last two stages; two in the *top-management* group, two in the *middle-management group*, and two is *immediate supervisor* group. Additionally, the groups *dispatch*, *pilot*, *cabin crew*, and *maintenance technicians* will each be represented by two participants. A company liaison will facilitate the sampling technique process.

To deter undue influence/cohesion of participants, the organization's liaison will forward recruiting email from investigators to the purposefully sampled potential participants of each targeted group. The recruitment email will have the investigators' contact information, and will direct potential participants to communicate directly to investigators with a decision on whether to participate in the study as well as for inquiries related to the study. Where more than two respondents per a targeted study group will respond positively, willingness to participate, investigators will randomize the final selection of participants.

32. Is participant contact information publicly available?

☒ NO
☐ YES - skip to question 35.

33. Will you obtain participant contact information from records?

☐ NO
☒ YES – Indicate record type below.
- ☐ Education records
- ☐ Employment records
- ☐ Medical Records

☒ Other – Explain: Investigators will not seek participants' contact information. However, investigators are likely to have access to some participants' email addresses and/or phone numbers to facilitate interview and focus group activities.

34. Explain how you will have permissible access to the records identified above.
Investigators will not have access to participants' contact information during the first phase of the research. A link to the online research questionnaire will be attached to recruitment statements on the intranet and electronic newsletters of the research subject's company. However, investigators are likely to come across participants' contact information during the interview and focus group activity phases of the study. A company's liaison, as determined by the subject company, will facilitate the purposeful sampling process for interview and focus group participants. To deter undue influence/cohesion of participants, the organization's liaison will forward recruiting email from investigators to potential participants. The email address will have investigators' contact information, and will request potential participants to communicate directly to investigators with a decision on whether to participate in the study as well as for inquiries related to the study. Participants could also potentially provide their telephone numbers to facilitate over-the-phone interview process.

COMPENSATION

35. Will you give the participants gifts, payments, compensation, reimbursement, or services in return for their participation in the research study? See guidance **Compensation for Research Participation.**

☒ NO - Skip to Principal Investigator's Assurance section.
☐ YES - Describe the compensation type (e.g. monetary, extra credit, etc.) and amount: _____

Extra credit – When extra credit is used as compensation for research participation, it cannot exceed 3% of the participant's grade. The investigator is obligated to make the class instructor aware of this limit and the requirement that students be offered an alternative non-research activity, comparable in time and effort, to earn a comparable amount of extra credit.

PRINCIPAL INVESTIGATOR'S ASSURANCE

As principal investigator of this study, I assure that the information supplied in this form and attachments are complete and correct. I have read the ***Researcher Responsibilities*** and will conduct this research in accordance with these requirements.

Principal Investigators Signature: _____ Date: _____

Submit this signed form and attachments to the Human Research Protection Program office either via hardcopy or electronically. **Forms received without signatures will be returned.** A signed form and attachments can be submitted electronically as an email attachment to irb@purdue.edu. If a signed form is submitted electronically, a paper copy need not be submitted.

Campus Address:
Human Research Protection Program

U.S Mail Address:
Human Research Protection Program

YONG 10th Floor, Rm. 1032
765-494-5942
irb@purdue.edu
Office Hours: M-F 8-11 am 1-5 pm

Purdue University
YONG, Rm. 1032
155 Grant Street
West Lafayette, IN 47906-2114

QUESTIONS? Call our office at 765-494-5942 or attend walk-in hours.

WALK-IN HOURS – Come speak to a Protocol Analyst
Monday 9:30 am - 11:30 am
Tuesday 2:00 pm - 4:00 pm
Thursday 9:30 am - 11:30 am

Appendix H Institutional Review Board Approval for the Study

PURDUE UNIVERSITY

HUMAN RESEARCH PROTECTION PROGRAM
INSTITUTIONAL REVIEW BOARDS

To:	RICHARD FANJOY AT 103
From:	JEANNIE DICLEMENTI, Chair Social Science IRB
Date:	11/20/2015
Committee Action:	**Exemption Granted**
IRB Action Date:	11/20/2015
IRB Protocol #:	1509016516
Study Title:	Perceptions of Safety Culture at a Regional Airline

The Institutional Review Board (IRB) has reviewed the above-referenced study application and has determined that it meets the criteria for exemption under 45 CFR 46.101(b)(2) .

If you wish to make changes to this study, please refer to our guidance "**Minor Changes Not Requiring Review**" located on our website at http://www.irb.purdue.edu/policies.php. For changes requiring IRB review, please submit an **Amendment to Approved Study** form or **Personnel Amendment to Study** form, whichever is applicable, located on the forms page of our website www.irb.purdue.edu/forms.php. Please contact our office if you have any questions.

Below is a list of best practices that we request you use when conducting your research. The list contains both general items as well as those specific to the different exemption categories.

General

- To recruit from Purdue University classrooms, the instructor and all others associated with conduct of the course (e.g., teaching assistants) must not be present during announcement of the research opportunity or any recruitment activity. This may be accomplished by announcing, in advance, that class will either start later than usual or end earlier than usual so this activity may occur. It should be emphasized that attendance at the announcement and recruitment are voluntary and the student's attendance and enrollment decision will not be shared with those administering the course.
- If students earn extra credit towards their course grade through participation in a research project conducted by someone other than the course instructor(s), such as in the example above, the students participation should only be shared with the course instructor(s) at the end of the semester. Additionally, instructors who allow extra credit to be earned through participation in research must also provide an opportunity for students to earn comparable extra credit through a non-research activity requiring an amount of time and effort comparable to the research option.
- When conducting human subjects research at a non-Purdue college/university, investigators are urged to contact that institution's IRB to determine requirements for conducting research at that institution.
- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without

proof of IRB approval, etc.), the investigator must submit the written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). This is an institutional requirement.

Category 1

- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval, etc.), the investigator must submit the written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). This is an institutional requirement.

Categories 2 and 3

- Surveys and questionnaires should indicate
  - only participants 18 years of age and over are eligible to participate in the research; and
  - that participation is voluntary; and
  - that any questions may be skipped; and
  - include the investigator's name and contact information.
- Investigators should explain to participants the amount of time required to participate. Additionally, they should explain to participants how confidentiality will be maintained or if it will not be maintained.
- When conducting focus group research, investigators cannot guarantee that all participants in the focus group will maintain the confidentiality of other group participants. The investigator should make participants aware of this potential for breach of confidentiality.
- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval, etc.), the investigator must submit the written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). This is an institutional requirement.

Category 6

- Surveys and data collection instruments should note that participation is voluntary.
- Surveys and data collection instruments should note that participants may skip any questions.
- When taste testing foods which are highly allergenic (e.g., peanuts, milk, etc.) investigators should disclose the possibility of a reaction to potential subjects.

VITA

VITA

Education

Ph.D. Technology - Aviation Concentration
Purdue University – West Lafayette, Indiana. May 2016

M.S. Safety Science. Concentrations - Aviation Safety; Industrial technology; and Systems safety and reliability.
Embry-Riddle Aeronautical University, Prescott, AZ. May 2008

B.S. Aerospace Studies. Minors – Aeronautical science, Computer applications, Business Administration. Embry-Riddle Aeronautical University, Prescott, AZ. May 2006

Academic Honors

Purdue Research Foundation Grant, 2015 - 2016
Julie Swengel Diversity Scholarship, 2015 - 2016
Third place, Virtual poster award, University Aviation Association conference, Fall, 2015
Outstanding Graduate, Embry Riddle Aeronautical University – Department of Behavior and Safety Sciences 2007, 2008
American Society of Safety Engineers Gold Country Section & Region II Scholarship, 2008

Research Experience

Perception of safety in U.S collegiate aviation, 2015

Aviation biofuel from corn stover, spring 2015

Manpower scheduling of baggage and cargo handlers, 2014

Teaching and Professional Experiences

Research Assistant – Purdue University – 2013 - 2016

Teaching Assistant – Purdue University, spring 2015

Continuing lecturer – Moi University – School of Aerospace Sciences 2010-2013

Human factors research scientist - EDGE3 Technologies, 2008

Simulator Build Assistant - InMotion Simulation Inc., 2007

Publications

Adjekum, D. K., Keller, J., Walala, M., Young, J. P., Christensen, C., & DeMik, R. J. (2015). Cross-sectional assessment of safety culture perceptions and safety behavior in collegiate aviation programs in the United States. *International Journal of Aviation, Aeronautics, and Aerospace*, *2*(4), 3. doi:10.15394/ijaaa.2015.1074

Rudari,L., Spence,T., Sperlak,L., Geske,R., Walala,M., Morris,C., Fernandes,M., Krsek,J., Hart,M., & Thanos,M. (2014, November). CRM-based training and its effect on aviation accident rates in the U.S. from 1960 to 2013. *Paper presented at the 67th annual international air safety summit, Abu Dhabi, UAE on November 11th - 13th 2014*

Keller, J. C., Walala, M. S., & Fanjoy, R. O. (2014). Interaction of weather and other contributing factors in general aviation instrument approach accidents. *Collegiate Aviation Review*, *32*(2).

Walala, M. & Mutinda, E. (2013). Evaluation of sustainable development in aviation industry: A case study of Kenya Airways (KQ) and Eldoret International Airport. *Journal of Economic and Sustainable Development*, *4*(9), 61-74

Walala, M. (2011). Examining the challenges facing the aviation industry in African – a case study of Kenya. *The 7th Annual International Conference, Knowledge Creation and Dissemination for the Realization of Millennium Development Goals*

Membership in Scientific and Educational Societies

Purdue Aviation Graduate Council
Flight Safety Foundation
Global Aviation Leadership Association