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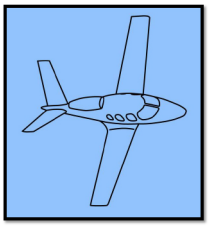

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Examining the Relationship Between Safety Management System Implementation and Safety Culture in Collegiate Flight Schools

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Abstract

Safety management systems (SMS) are becoming the industry standard for safety management throughout the aviation industry. As the Federal Aviation Administration continues to mandate SMS for different segments, the assessment of an organization's safety culture becomes more important. An SMS can facilitate the development of a strong aviation safety culture. This study describes how safety culture and SMS are integrated.

The purpose of this study was to examine the relationship between an organization's safety culture and SMS implementation in collegiate flight schools. The research study was designed to determine (a) the relationship between SMS implementation and safety culture, (b) the relationship between safety promotion and safety culture, and (c) the relationship between management commitment and safety culture. The study population consisted of 453 students and employees from 13 collegiate flight schools. Data were gathered through an online survey at collegiate flight schools within the University Aviation Association utilizing the Collegiate Aviation Program Safety Culture Survey (CAPSCUS) to measure the safety culture at those collegiate flight schools.

The results indicated that a relationship existed between SMS implementation and safety culture, safety promotion and safety culture, management commitment and safety culture. The relationship for all three was more prominent within the Formal Safety Program major scale of the CAPSCUS.

Keywords: SMS, safety culture, collegiate flight schools

Introduction

An integral aspect of a safely management system (SMS) is a positive safety culture. The Chernobyl accident was the first in which a failed safety culture was cited as a contributory factor following the investigation of the accident. Even before Chernobyl, the concept that an organization's attitudes and beliefs established its policies and procedures and that those attitudes and beliefs affected the organization's safety performance was an accepted theory. This belief existed even as far back as 1930 (Ostrom, Wilhelmsen, & Kaplan, 1993). An organization cannot have a successful SMS without this strong safety culture and invariably a strong safety culture helps in the development of an SMS (Stolzer, Goglia, & Halford, 2011). SMS provides a framework for an organization to manage safety and serves as a structure to build a positive safety culture (von Thaden & Gibbons, 2008). According to AC 120-92A (Federal Aviation Administration [FAA], 2010), "an organization's

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culture consists of its values, beliefs, legends, rituals, mission goals, performance measures, and sense of responsibility to its employees, customers, and the community" (p. 3). It is important to note that an "SMS was not designed to create a 'culture of safety,' an SMS was designed to build upon and improve an existing 'culture of safety'" (Garcia & Boyer, n.d., p. 2).

Reason (1997) described a positive safety culture as one that demonstrates competence, the ability to gather and disseminate safety information; commitment, which is the motivation and resources to pursue safety goals; and cognizance, which is an awareness of the risk factors. Palframan (1994) also focused on the involvement of all personnel in promoting safety, commitment to safety from senior management, and not appointing blame and lessons learned from accidents and incidents. Pidgeon (1991) described a healthy safety culture as having well-developed norms and rules to promote safety, an informed and healthy attitude toward risk, and mechanisms to provide feedback concerning safety performance.

The safety health of an organization is generally based on two key factors: competence and commitment. Competence is the quality of the organization's safety systems and processes. Competence refers to the SMS. The second feature is commitment. Commitment refers to how safety is valued and managed by people in the organization, which includes beliefs, attitudes, and behaviors; in other words, safety culture (Wang, 2011). The link between the competence–SMS and commitment–safety culture often characterizes the way people within an organization behave, and is referred to as behavioral norms. The nature by which safety within an organization is managed is influenced by the culture of the organization. If an organization has a well-developed SMS and a strong safety culture, the organization will then achieve a level of safety that reduces hazards as much as practicable (Wang, 2011). For commitment and competence to remain strong within an organization, senior management has to remain committed towards making safety a priority (Wang, 2011).

A strong tie exists between organizational accidents and a failed safety culture. Measuring safety culture is a key aspect within an SMS and continuous improvement. Many studies have assessed safety culture in a variety of organizations (Cox & Flin, 1998; Freiwald, Lenz-Anderson, & Baker, 2013; Gill, 2004; Hanks, 2011; Lee & Weitzel, 2005; McNeely, 2012; Pidgeon, 1998). However, few studies exist addressing the relationship between SMS implementation and its impact on developing a strong safety culture (McNeely, 2012). Few studies have been conducted that have attempted to identify if there is a relationship between SMS implementation and safety culture in collegiate flight schools (Robertson, 2016). The purpose of this study is to examine the relationship between SMS implementation and safety culture at collegiate flight schools.

Research Questions

The purpose of this study was to examine the relationship between SMS implementation and safety culture at collegiate flight schools. The research questions used to examine this relationship include the following:

1. What is the relationship between SMS implementation and safety culture at collegiate flight schools?
2. What is the relationship between the level of promotion and the safety culture at collegiate flight schools?
3. What is the relationship between the level of management commitment and safety culture at collegiate flight schools?

Background

All four components of SMS must exist and be executed for an effective SMS to exist within an organization. A strong safety culture is an integral part of SMS.

> Some of the key characteristics of SMS that are reflected in the framework developed by ICAO are that it is: a dynamic risk management system; it is based on quality management system (QMS) principles; it exists in a structure scaled appropriately to the operational risk; and it is applied in a safety culture environment. (Stolzer et al., 2015, p. 35)

As early as 1996, Horbury identified that the goal of an SMS is the development of a safety culture. SMS will only work if individuals within an organization are motivated to conform and comply with the organization's desire (Horbury, 1996). For organizations to be safe and to have a good safety culture, it is important for structures to be in place to enhance organizational learning (Horbury, 1996). Cooper (1998) noted that

> the situational aspects of safety culture tend to be reflected in organizational policies, operating procedures, management systems, control systems, communication flows and workflow systems as well as factors such as noise, heat, light, and physical proximity associated with the immediate working environment. As such, this wide range of cultural influences should be measured via audits of Safety Management Systems. (p. 10)

An organization cannot have a successful SMS without this strong safety culture; and invariably a strong safety culture helps in the development of an SMS (Stolzer et al., 2011). A safety culture can be challenging to define. This difficulty occurs because each organization is unique. Many different features or aspects can influence safety culture. The nation or region where the organization is located, technology, as well as successes and failures of the organization

are all factors affecting safety culture (Ostrom et al., 1993). The FAA (2015b) described components of safety culture as "psychological (how people think and feel), behavioral (how people and groups act and perform), and organizational or systematic (the programs, procedures, and organization of the enterprise) elements" (p. 3). The importance of safety culture is underscored further by the FAA's guidance in AC 120-92B (2015b), which stated the following:

> One key aspect that is essential to safety performance is the culture of an organization. "Safety Culture" is the term that we apply those aspects of the organization's culture that relate to safety performance. The concept of safety culture underlies safety management and is the basis for the SMS requirement. (p. 3)

It is recommended that in order to improve an organization's safety culture, the safety culture needs to be defined. After the culture is developed, an SMS is then ready to be established. The first and most important step in establishing an SMS is to measure the existing safety culture (Garcia & Boyer, n.d.).

> Remember that an SMS is a system, not a program, and is based on a "culture of safety." It was not designed to create a "culture of safety." It was designed to build upon and improve an existing "culture of safety." By defining your existing safety culture first and then nurturing that culture to an appropriate level, your department will reap the rewards of operational excellence and effectively and proactively control your hazards through a successfully implemented SMS. (Garcia & Boyer, n.d., p. 5)

Within the aviation industry, there are many organizations that continuously strive to improve their SMS, or other safety program, by assessing their current safety culture (Freiwald et al., 2013; Gill, 2004; Hanks, 2011; Lee & Weitzel, 2005). Whether an organization has a traditional safety program or an SMS, it is widely recognized throughout the aviation industry that an SMS facilitates a positive safety culture. In 2010, Ireland utilized a safety culture survey to measure the safety culture in the aviation industry. The aviation industry consisted of just over 11,000 employees. Over 1,000 people submitted a survey, which was more than what was expected. The survey revealed that the respondents had a strong knowledge of SMS as well as a positive safety culture throughout the industry (Ireland Aviation Authority, 2011).

Adjekum (2013) conducted an assessment of safety culture at an accredited four-year collegiate aviation program. The population of this study was students, including a large international population and flight instructors. The purpose of the study was to assess the perception of safety culture between the different groups within the population. A further goal of the study was "to establish a safety culture assessment methodology, which could be replicated in other similar collegiate aviation programs for comparison results and ultimately the continuous improvement of collegiate aviation safety" (Adjekum, 2013, p. 6).

Adjekum found that the longer a participant had been in the organization, the better the perception they had concerning safety culture. Overall there was a positive perception of safety culture throughout the study. However, there was a significant difference in perceptions of safety culture between international students and American students. International students' perceptions of safety culture were less favorable than those of the American students (Adjekum, 2013). The study recommended changes to the international program to take the effect of national culture on safety culture into consideration.

As a result of that study, Adjekum (2013) had several recommendations for further study. The author recommended that a future assessment of management on the safety culture of an organization correlated with student perceptions could help gauge the extent of SMS saturation. Further studies similar to this should be conducted at other universities. The results of these studies could be cross-validated to build a usable database for predictive safety studies. This could help provide a baseline for the development, implementation, and continuous improvement of SMS in collegiate aviation programs (Adjekum, 2013).

Similar to Adjekum (2013), Adjekum et al. (2015) conducted a study utilizing a modified version of the Collegiate Aviation Program Safety Culture Survey (CAPSCUS) referred to as the Collegiate Aviation Perception of Safety Culture Assessment Survey (CAPSCAS) to help further validate the instrument. The purpose of the study was to investigate how safety culture perceptions of the respondents influenced their safety reporting behavior. Participants were recruited from five collegiate aviation programs. One of the main objectives of the study was to determine safety culture perception variables that would predict safety reporting behavior and if there was a significant difference of safety reporting behavior among basic demographic variables. The CAPSCAS utilizes six primary dimensions with 69 items with subscales for each dimension. The primary dimensions include the following: Operations Interactions (OI), Formal Safety (FS), Informal Safety (IS), Aviation Department Safety Record (ADSR), Organizational Commitment (OC), and Safety Behavior (SB). Those main dimensions have subscales (Adjekum et al., 2015). This was a departure from the original CAPSCUS, which utilized the above dimensions without ADSR and SB.

This study utilized the survey items within the CAPSCAS from the subscales from the Reporting System dimension. A cross-sectional quasi-mixed methods approach was utilized to determine the relationship between safety culture and safety reporting. Demographic data were analyzed as well as qualitative methods being used for data collection. The findings from the study suggested that when management of

collegiate aviation programs provides effective feedback on safety issues, a positive perception of safety culture increases within the organization. The authors also concluded that it is important to have a healthy safety foundation and framework within collegiate aviation programs.

The results of this study were similar to those of Friewald et al. (2011), which suggested that generally the respondents thought that safety reporting systems were important but they did not participate in the safety reporting system at their organization. Adjekum et al. (2015) noted that, "When respondents operate in a proactive safety environment and feel that safety concerns are adequately and expeditiously addressed, respondents may develop a positive perception of the prevalent safety in the program" (p. 16).

The researchers recommended that safety awareness and safety reporting programs are extended to all stakeholders within an organization. Furthermore, like Adjekum (2013), the authors recommended future studies to be conducted to further validate assessments like the CAPSCUS/CAPSCAS. Finally, they recommended safety culture studies comparing safety culture perceptions for various demographic groups such as managers, employees, or students should be conducted.

In 2016, Robertson (2016) conducted a qualitative study to investigate the relationship between SMS elements and process and safety culture in collegiate flight training institutions. The author interviewed five safety professionals at various flight training institutions around the country utilizing a semi-structured interview. Of the five institutions interviewed, only two had a fully developed and implemented SMS. One of the findings was that it was considered among all the participants that a confidential hazard reporting system was one of the most important aspects in building a strong safety culture. Other elements of SMS that contributed were a strong training program and the SRM five-step processes. Robertson (2016) recommended that both quantitative and qualitative studies continue to examine the relationship between SMS and safety culture.

Methods and Procedures

The study participants include management, employees, and students from collegiate flight schools who are members of the University Aviation Association. The sampling design for this study is a non-probability convenience sampling technique. This study builds from a previous study by Robertson, Romero, and Goetz that investigated the status of SMS in collegiate flight schools. Thirteen of those schools that participated in that study consented to be surveyed for this study. The study population consisted of 453 individuals from those schools to assess the safety culture within the organizations. The CAPSCUS was utilized to assess the safety culture at each institution.

The CAPSCUS was emailed to the safety officers of participating institutions for dissemination to students, faculty, and staff. If participants did not respond, a follow-up request was sent one more time within two weeks after the initial survey. Participants had the opportunity to opt out of the study and to not receive any future emails. Each participant was emailed a letter stating the purpose of the study and told that the study was strictly voluntary, and that all information would be kept confidential.

Collegiate Aviation Program Safety Culture Survey

The survey used was the CAPSCUS (Adjekum, 2013), which was derived from the Commercial Aviation Safety Survey (CASS). The CASS was designed as a means to measure the overall safety culture of an airline. The CASS measures five organizational indicators of safety culture. The indicators were defined and synthesized from common themes in safety culture researched previously by Wiegmann, Zhang, von Thaden, Sharma, and Gibbons (2004). Also, Ostrom et al. (1993) stated, "A properly structured survey instrument has been shown to be a very effective tool for assessing safety culture in organizations" (p. 169).

The five-factor model of CASS includes organizational commitment, management involvement, pilot empowerment, reporting systems, and accountability systems as they relate to safety within an airline. The survey is comprised of 84 items that occur in random order throughout the instrument. The items include an accountability system ($n = 10$), management involvement ($n = 17$), organizational commitment ($n = 30$), pilot empowerment ($n = 14$), and reporting system ($n = 13$). The instrument utilizes a 7-point Likert scale ranging from 1 (strongly disagree) to 4 (neither agree nor disagree) and to 7 (strongly agree), with only those three points labeled (Gibbons, von Thaden, & Wiegmann, 2005). A later version of the instrument moved from this 7-point scale to a 5-point Likert scale due to negative participant response given the high number of items on the instrument.

Gibbons et al. (2005) continued research to validate the CASS by utilizing the survey to assess safety culture in airline maintenance operations. The maintenance version of the survey was designed with the same structure as the version for flight operations. This survey applied to the five indicators of safety culture previously mentioned. Results of a factor analysis supported three of the factors which included an accountability system, reporting system, and management/supervisory involvement. Organizational commitment and employee empowerment did not result in a good fit to the data. These findings were consistent with the flight operations version of the survey. The authors recognized that the instrument seems useful in identifying strengths and weaknesses of airline maintenance safety culture. However, they also recognized that more modification is necessary to the instrument for future research.

Adjekum (2013) and Freiwald et al. (2013) conducted studies that utilized an adaptation of the CASS to flight training organizations. Adjekum (2013) had the adaptation approved by von Thaden (2012) and Creswell (2009). The CASS was adapted to the CAPSCUS. Adjekum (2013) conducted a factor analysis in the form of a principal component analysis on the modified questions to check for content validity. A reliability check for all scales was conducted using the Cronbach alpha coefficient.

The CAPSCUS utilizes four major factor scales which include Formal Safety Program, Informal Safety Program, Operations Interaction, and Organizational Commitment. The CAPSCUS also includes a Safety Behavior Scale that includes perceptions of personal and organizational risk. The CAPSCUS also has multiple subfactor scales (Adjekum, 2013). Table 1 outlines the major scales and subscales of the CAPSCUS.

Data Analysis

The study made use of a non-experimental comparative research design. The purpose of the study was to investigate the relationship between SMS implementation, management commitment, and promotion and the safety culture of the flight training organizations. The SMS implementation, management commitment, and promotion were the independent variables, and the CAPSCUS was the instrument used to measure the safety culture, which is the dependent variable.

The data from the CAPSCUS violated the assumption of normality and homogeneity, as it did not form a normal distribution. Because of this, non-parametric tests were chosen. A Cronbach alpha coefficient was accomplished on the CAPSCUS data to determine reliability. Further data analysis was accomplished using descriptive statistics and the Spearman ρ for correlation between the schools and the subscales. Finally, the Spearman ρ was used to find the correlation between SMS implementation, safety promotion, and management commitment with safety culture subscales. Quantitative data were imported into the Statistics Program for Social Sciences (SPSS) version 22 and analyzed. Statistically significant values were set at the 0.05 levels.

Table 1
*Scales inventory for the CAPSCUS as modified from the CASS (*Adjekum, 2013).

CAPSCUS Major Factor Scales	Subfactor Scales
Formal Safety Program	Reporting System
	Response and Feedback
	Safety Personnel
Informal Safety Program	Accountability
	Pilot Authority
	Professionalism
Operations Interaction	Supervisor of Flight/Chief Flight Instructor
	Dispatch
	Instructors
	Ground and Ramp Personnel
Organizational Commitment	Safety Values
	Safety Fundamentals
	Going Beyond Compliance
Safety Behavior	Personal Risk
	Organizational Risk

Demographics

Thirteen schools participated in the second phase of this study and agreed to forward the CAPSCUS to individuals within their institution. Each school was given a reference number. Three schools (6, 8, and 18) chose not to forward the CAPSCUS to students and sent it only to the faculty and flight instructors. One school (5) chose only to forward it to the students. The first question asked on the CAPSCUS was to name the institution. Because each institution received its own version of the CAPSCUS, this created redundancy to match individuals to the correct school. Basic demographics included the primary responsibility of the respondent within the flight training institution (see Table 2).

Most of the respondents (91%, 419) reported that they had associated with their school for less than five years. The majority of respondents (76%) reported that they were under the age of 30 (students). Respondents were also asked to report the number of times they had reported a safety problem at their college/university within the last year. The majority of the respondents had not submitted a report within the last year (67.5%).

Finally, the respondents were asked their gender. Most of the participants, 396 (87%), were male. The rest were female with one respondent selecting other. Two other demographic questions were asked, including certificates and ratings and academic group for students. The information gathered from these questions was not used for the purposes of this study, but the questions were asked to prepare a follow-up study concerning those groups. All of the schools except for five within this study have some aspects of SMS under development. Those schools that do not have SMS under development are schools 3, 5, 6, 18, and 21. However, they did report that they had some SMS elements and processes.

Reliability

Reliability of the CAPSCUS responses was checked using the Cronbach's alpha for all four major scales (Formal Safety, Informal Safety, Operational Interaction, and Organizational Commitment). All four major scales and Safety Behavior revealed high reliabilities. All of the subscales were checked as well, and also displayed high consistencies.

Table 2
Primary responsibility of respondents by collegiate flight school.

Primary Responsibility	School Reference Number												
	1	**3**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**15**	**18**	**20**	**21**
Flight Instructor	3	27	0	2	0	4	8	12	1	5	7	22	5
Assistant Chief	0	3	0	1	0	0	0	5	0	0	0	0	1
Faculty	0	2	0	1	1	0	0	2	0	0	0	1	0
Safety Department	1	0	0	0	0	0	0	0	0	0	0	1	0
Administration	1	5	0	0	0	1	0	1	0	0	0	1	0
Admin Staff	0	6	0	0	0	0	1	1	0	0	0	0	0
Line Service	0	0	0	0	0	1	0	2	2	0	0	3	0
Maintenance	0	15	0	0	0	1	0	2	0	0	0	3	1
Dispatch	0	3	0	0	0	0	0	4	0	1	0	2	0
Student	4	3	9	0	18	0	23	81	4	19	0	106	5
Other	0	4	1	0	0	0	1	0	0	0	0	2	1
Total	9	68	10	4	19	7	33	110	7	25	7	141	13

Table 3
Cronbach's alpha for major factor scales and subfactor scales.

CAPSCUS Major Factor Scales	Cronbach's α	Subfactor Scales	Cronbach's α
Formal Safety Program (15)	0.912	Reporting System (5)	0.830
		Response and Feedback (5)	0.785
		Safety Personnel (5)	0.842
Informal Safety Program (14)	0.912	Accountability (4)	0.826
		Pilot Authority (5)	0.812
		Professionalism (5)	0.772
Operations Interaction (19)	0.925	Supervisor of Flight/Chief Flight Instructor (5)	0.783
		Dispatch (4)	0.792
		Instructors (4)	0.842
		Ground and Ramp Personnel (6)	0.893
Organizational Commitment (15)	0.923	Safety Values (5)	0.853
		Safety Fundamentals (6)	0.881
		Going Beyond Compliance (4)	0.788
Safety Behavior (14)	0.926	Personal Risk (7)	0.834
		Organizational Risk (7)	0.914

Note. Values in parentheses denote number of items in each scale.

The values for reliabilities for the major scales and subscales are outlined in Table 3.

Subscale Descriptive

There were 453 surveys filled out from the 13 schools. As mentioned previously, the CAPSCUS is comprised of 13 subscales with the addition of Safety Behavior. Aggregate scores from each survey were totaled for each subscale and for Safety Behavior. Safety Behavior was treated as a subscale, due to it not being a true major scale. Tests for normality were conducted on each subscale for every school. The data in every subscale violated the assumption of normality and homogeneity. Table 4 displays the descriptive statistics for each subscale. Missing values vary for each subscale. There are two reasons for this. The first is that several respondents chose not to answer questions within a subscale or did not answer the subscale because it did not apply to them within their job. For example, the safety behavior scale asked several questions that related more to pilots. The second is that there were many respondents that stopped the survey at various places within the instrument. All responses were left in the survey no matter where they elected to stop. However, the missing data in the subscale totals were not used in the data analysis calculations.

Data Analysis

A school-by-school analysis was completed to determine what SMS elements and processes each school had by SMS component. There are four components of SMS: Safety Policy, Safety Risk Management, Safety Assurance, and Safety Promotion. Each school was given a value based on the number of processes and elements that they had within each component. For example, if a school had seven of the nine elements within Safety Promotion, they were given a score of seven. This process was accomplished for every school for every component as well as an overall SMS implementation score based on a total of 30 elements and processes. Tables 5–8 display the elements and processes for each component and school-by-school comparison.

Table 4
Descriptive statistics for CAPSCUS subscales.

CAPSCUS Subscale	*N*	Missing	Mean	Median	α
Reporting System	426	27	18.15	19.00	4.25
Response and Feedback	421	32	18.28	19.00	4.23
Safety Personnel	409	34	19.83	20.00	3.95
Accountability	409	44	14.10	15.00	3.60
Pilot Authority	401	52	16.89	17.00	4.35
Professionalism	390	63	15.78	16.00	3.28
Supervisor of Flight/Chief Flight Instructor	389	64	17.70	18.00	3.54
Dispatch	385	68	13.94	15.00	4.12
Instructors	390	63	16.50	17.00	2.90
Ground and Ramp Personnel	384	69	22.98	24.00	5.27
Safety Values	391	62	19.57	20.00	4.05
Safety Fundamentals	387	66	24.35	25.00	4.83
Going Beyond Compliance	384	69	15.36	16.00	3.08
Safety Behavior	370	83	31.64	33.00	9.14

Table 5
Safety policy (planning and organization).

Element/Process	School Reference Numbers												
	20	15	7	10	11	9	8	5	1	21	6	18	3
Completed Gap Analysis	X	X	X		X	X							
Implementation Plan	X	X	X	X	X	X	X						
Safety Policy Statement	X	X	X	X	X	X		X	X			X	
SMS Objectives	X	X	X	X			X	X		X	X		
Identified Accountable Executive	X	X	X	X	X	X	X	X	X				
Identified SMS Manager/Coordinator	X	X	X	X	X	X	X	X	X	X	X		
Identified Safety Committee	X	X	X	X	X		X		X				
Emergency Planning and Response	X	X	X	X		X	X	X	X	X		X	X

Table 6
Safety risk management.

Element/Process	School Reference Numbers												
	20	7	10	8	11	5	15	9	1	6	18	3	21
Hazard Identification	X	X	X	X	X	X	X	X	X		X	X	
Hazard Tracking and Documentation	X	X	X	X		X	X	X	X		X		X
Risk Analysis	X	X	X	X	X	X	X	X		X		X	
Established 5-Step SRM Process	X	X	X	X	X								
Conducted Safety Risk Assessments	X	X	X	X	X	X			X	X			

Table 7
Safety assurance, continuous improvement.

Element/Process	School Reference Numbers												
	20	15	10	9	8	1	7	18	5	11	6	21	3
Confidential Hazard Reporting: Paper	X	X				X			X	X	X		
Confidential Hazard Reporting: Web	X	X	X	X	X	X	X	X				X	
Trend Analysis	X	X	X	X	X		X	X		X			
Safety Performance Monitoring	X	X	X		X	X		X					
Continuous Monitoring of Controls	X	X	X		X	X							
Flight Data Monitoring Analysis	X			X	X				X		X	X	
SMS Audits or Evaluations	X	X		X									
Safety Culture Assessments	X		X	X		X	X		X				X

Table 8
Safety promotion.

Element/Process	School Reference Numbers												
	20	**7**	**8**	**10**	**18**	**9**	**1**	**15**	6	**11**	**5**	**3**	**21**
Specialized SMS Training	X	X	X			X							
SMS Training for Employees	X	X	X	X	X								
SMS Training for Students	X	X	X	X	X								
Safety Bulletin Boards	X	X	X	X	X	X	X	X	X	X	X		
Safety Newsletters	X		X	X			X	X	X	X			
Employee Safety Meetings	X	X	X	X	X	X	X	X	X	X	X	X	X
Student Safety Meetings	X	X	X	X	X	X	X	X	X		X		
Safety Awards Program	X					X							
Safety Stand Downs	X	X			X		X			X			

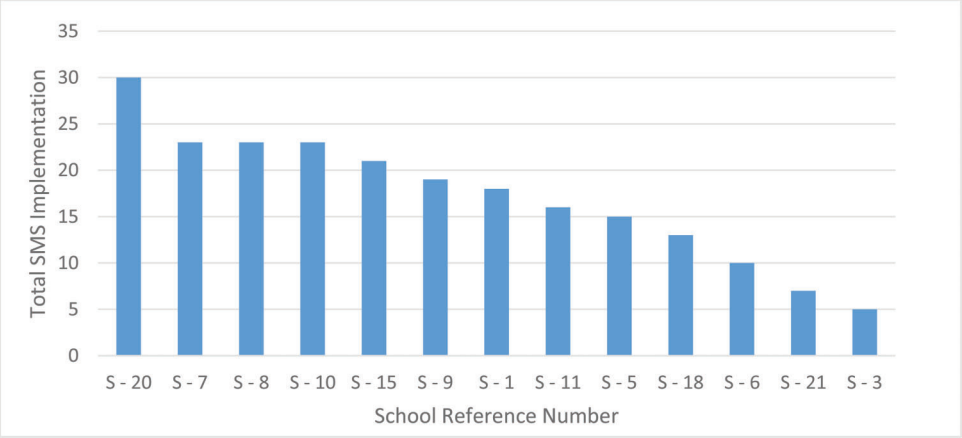

Figure 1. Total SMS implementation by school reference number.

The total SMS implementation was also conducted. There were 30 elements and processes. Only one school (20) had all of the items for total SMS implementation. Figure 1 displays the total SMS elements and processes for each school.

To determine if there was a relationship in SMS implementation and safety culture, a Spearman ρ correlation was conducted. The correlation was conducted based on the elements and processes within each school as previously described for each component and the CAPSCUS subscales. Tables 9–13 display the Spearman ρ for each SMS component and overall SMS implementation.

There were weak positive and negative correlations between the level of SMS Policy and the subscale variables. Five variables were found to be statistically significant: Reporting System, $r_s = 0.121$, $p = 0.013$; Response and Feedback, $r_s = 0.211$, $p = 0.000$; Safety Personnel, $r_s = 0.221$, $p = 0.000$; Dispatch, $r_s = 0.258$, $p = 0.000$; and Safety Fundamentals, $r_s = 0.247$, $p = 0.000$.

Within the Safety Risk Management component, there were five variables found to be statistically significant: Response and Feedback, $r_s = 0.162$, $p = 0.001$; Safety Personnel, $r_s = 0.208$, $p = 0.000$; Accountability, $r_s = 0.109$, $p = 0.028$; Dispatch, $r_s = 0.132$, $p = 0.010$; and Safety Fundamentals, $r_s = 0.146$, $p = 0.004$.

Table 9
Safety Policy Spearman ρ correlation coefficient.

CAPSCUS Subscale	Spearman ρ	Sig.
Reporting System	0.121*	0.013
Response and Feedback	0.211**	0.000
Safety Personnel	0.221**	0.000
Accountability	0.092	0.063
Pilot Authority	−0.040	0.428
Professionalism	−0.085	0.094
Supervisor of Flight/Chief Flight Instructor	0.063	0.214
Dispatch	0.258**	0.000
Instructors	0.079	0.121
Ground and Ramp Personnel	0.027	0.605
Safety Values	−0.037	0.461
Safety Fundamentals	0.247**	0.000
Going Beyond Compliance	−0.013	0.800
Safety Behavior	−0.070	0.178

Note. **Correlation is significant at the 0.01 level; *correlation is significant at the 0.05 level.

Within the Safety Assurance component, there were seven variables found to be statistically significant: Reporting System, $r_s = 0.162$, $p = 0.001$; Response and Feedback, $r_s = 0.221$, $p = 0.000$; Safety Personnel, $r_s = 0.226$, $p = 0.000$; Accountability, $r_s = 0.170$, $p = 0.001$; Dispatch, $r_s = 0.216$, $p = 0.000$; Instructors, $r_s = 0.100$, $p = 0.049$; and Safety Fundamentals, $r_s = 0.345$, $p = 0.000$.

Table 10
Safety Risk Management Spearman ρ correlation coefficient.

CAPSCUS Subscale	Spearman ρ	Sig.
Reporting System	0.043	0.373
Response and Feedback	0.162**	0.001
Safety Personnel	0.208**	0.000
Accountability	0.109*	0.028
Pilot Authority	−0.014	0.784
Professionalism	−0.130	0.937
Supervisor of Flight/Chief Flight Instructor	−0.004	0.943
Dispatch	0.132**	0.010
Instructors	0.006	0.902
Ground and Ramp Personnel	−0.059	0.246
Safety Values	−0.111	0.028
Safety Fundamentals	0.146**	0.004
Going Beyond Compliance	−0.090	0.078
Safety Behavior	−0.153	0.003

Note. **Correlation is significant at the 0.01 level; *correlation is significant at the 0.05 level.

Table 11
Safety Assurance Spearman ρ correlation coefficient.

CAPSCUS Subscale	Spearman ρ	Sig.
Reporting System	0.162**	0.001
Response and Feedback	0.221**	0.000
Safety Personnel	0.226**	0.000
Accountability	0.170**	0.001
Pilot Authority	0.066	0.185
Professionalism	0.013	0.800
Supervisor of Flight/Chief Flight Instructor	0.063	0.217
Dispatch	0.216**	0.000
Instructors	0.100*	0.049
Ground and Ramp Personnel	0.034	0.512
Safety Values	−0.021	0.677
Safety Fundamentals	0.345**	0.000
Going Beyond Compliance	−0.034	0.507
Safety Behavior	−0.012	0.811

Note. **Correlation is significant at the 0.01 level; *correlation is significant at the 0.05 level.

Table 12
Safety Promotion Spearman ρ correlation coefficient.

CAPSCUS Subscale	Spearman ρ	Sig.
Reporting System	0.143**	0.003
Response and Feedback	0.249**	0.000
Safety Personnel	0.269**	0.000
Accountability	0.147**	0.003
Pilot Authority	0.038	0.450
Professionalism	−0.035	0.117
Supervisor of Flight/Chief Flight Instructor	0.090	0.076
Dispatch	0.208**	0.000
Instructors	0.080	0.115
Ground and Ramp Personnel	0.030	0.552
Safety Values	−0.028	0.583
Safety Fundamentals	0.359**	0.000
Going Beyond Compliance	−0.016	0.759
Safety Behavior	−0.025	0.635

Note. **Correlation is significant at the 0.01 level.

Table 13
Overall SMS implementation Spearman ρ correlation coefficient.

CAPSCUS Subscale	Spearman ρ	Sig.
Reporting System	0.121*	0.012
Response and Feedback	0.239**	0.000
Safety Personnel	0.236**	0.000
Accountability	0.140**	0.005
Pilot Authority	0.032	0.517
Professionalism	−0.053	0.295
Supervisor of Flight/Chief Flight Instructor	0.033	0.513
Dispatch	0.199**	0.000
Instructors	0.041	0.417
Ground and Ramp Personnel	−0.014	0.786
Safety Values	−0.069	0.176
Safety Fundamentals	0.310**	0.000
Going Beyond Compliance	−0.076	0.139
Safety Behavior	−0.094	0.070

Note. **Correlation is significant at the 0.01 level; *correlation is significant at the 0.05 level.

Within the Safety Promotion component, there were nine variables found to be statistically significant. Many of the variables were the same variables that were statistically significant in Safety Assurance: Reporting System, $r_s = 0.143$, $p = 0.003$; Response and Feedback, $r_s = 0.249$, $p = 0.000$; Safety Personnel, $r_s = 0.269$, $p = 0.000$; Accountability, $r_s = 0.147$, $p = 0.003$; Dispatch, $r_s = 0.208$, $p = 0.000$; and Safety Fundamentals, $r_s = 0.359$, $p = 0.000$.

Within the overall SMS implementation of the schools, statistically significant results were found in the same variables that were found within the Safety Promotion component: Reporting System, $r_s = 0.121$, $p = 0.012$; Response and Feedback, $r_s = 0.239$, $p = 0.000$; Safety Personnel, $r_s = 0.236$, $p = 0.000$; Accountability, $r_s = 0.140$, $p = 0.005$; Dispatch, $r_s = 0.199$, $p = 0.000$; and Safety Fundamentals, $r_s = 0.310$, $p = 0.000$.

For every Spearman correlation that was conducted on the SMS components and the total SMS implementation, there were consistent statistically significant results. The subscales within the Formal Safety major scale consistently displayed a statistical significance to each SMS component. Informal Safety had one subscale, Accountability, which was consistently statistically significant. Operational Interaction had one scale, Dispatch, that was consistently statistically significant. The Instructor subscale had a statistically significant relationship with Safety Assurance. The only subscale within Organizational Commitment that had a statistical significant relationship with the SMS components was Safety Fundamentals.

At the end of the CAPSCUS the respondents were asked about the university's safety record. This section related to each respondent's perception regarding the probability of the university experiencing an incident or an accident over the next 12 months. This section was not considered a major scale or a subscale regarding safety culture. However, a Spearman ρ correlation was done to see if there was any

Table 14
Management Commitment Spearman ρ correlation coefficient.

CAPSCUS Subscale	Spearman ρ	Sig.
Reporting System	0.137**	0.004
Response and Feedback	0.280**	0.000
Safety Personnel	0.270**	0.000
Accountability	0.147**	0.003
Pilot Authority	−0.001	0.992
Professionalism	−0.063	0.218
Supervisor of Flight/Chief Flight Instructor	0.105*	0.039
Dispatch	0.227**	0.000
Instructors	0.079	0.118
Ground and Ramp Personnel	0.072	0.159
Safety Values	0.006	0.906
Safety Fundamentals	0.228**	0.000
Going Beyond Compliance	0.007	0.889
Safety Behavior	−0.073	0.160

Note. **Correlation is significant at the 0.01 level; *correlation is significant at the 0.05 level.

Table 15
CAPSCUS subscale Spearman ρ correlation coefficient.

CAPSCUS Subscale	Spearman ρ	Sig.
Reporting System	0.060	0.219
Response and Feedback	0.188**	0.000
Safety Personnel	0.151**	0.002
Accountability	0.085	0.086
Pilot Authority	0.005	0.917
Professionalism	−0.025	0.620
Supervisor of Flight/Chief Flight Instructor	0.039	0.446
Dispatch	0.127*	0.012
Instructors	0.024	0.630
Ground and Ramp Personnel	0.012	0.810
Safety Values	−0.027	0.595
Safety Fundamentals	0.268**	0.000
Going Beyond Compliance	−0.077	0.132
Safety Behavior	−0.022	0.679

Note. **Correlation is significant at the 0.01 level; *correlation is significant at the 0.05 level.

relationship between SMS implementation and each respondent's perception of the university's safety record. The results of the Spearman ρ correlation indicate that a negative relationship exists between the components of SMS and the total implementation. The Safety Risk Management component ($r_s = -0.146$, $p = 0.005$) and the Safety Assurance component ($r_s = -0.104$, $p = 0.044$) showed statistically significant weak negative correlations with university safety record.

Management commitment was also correlated to the subscale variables (Table 14). The number of items that the safety officer selected on the SMS implementation survey determined the level of management commitment. There were five items that were included to determine the level: invests in human resources and financial resources, proactive in preventing accidents, consistently enforces safety procedures, views regulatory violations seriously, and involved in safety activities. Each safety officer from every school selected at least four of the five items. Correlation was done based on those answers and the subscale variable. Similar to the SMS components, weak relationships existed. However, similar subscales were indicated as having a statistically significant relationship to management commitment: Reporting System, $r_s = 0.137$, $p = 0.004$; Response and Feedback, $r_s = 0.280$, $p = 0.000$; Safety Personnel, $r_s = 0.270$, $p = 0.000$; Accountability, $r_s = 0.147$, $p = 0.005$; Supervisor of Flight/Chief Flight Instructor, $r_s = 0.105$, $p = 0.039$; Dispatch, $r_s = 0.227$, $p = 0.000$; and Safety Fundamentals, $r_s = 0.228$, $p = 0.000$.

To determine how consistent the responses were from each school for each subscale, a Spearman ρ correlation was conducted. All of the subscales showed a positive relationship except for Professionalism, Safety Values, Going Beyond Compliance, and Safety Behavior. Most of the scales indicated a weak relationship with only four showing a statistical significance. Those four were Response and Feedback, $r_s = 0.188$, $p = 0.000$; Safety Personnel, $r_s = 0.151$, $p = 0.002$; Dispatch, $r_s = 0.127$, $p = 0.012$; and Safety Fundamentals, $r_s = 0.268$, $p = 0.000$. Table 15 displays the Spearman ρ relationship between the responses to the various subscales and the schools.

Conclusions and Recommendations

The purpose of this study was to examine the relationship between SMS implementation and safety culture at collegiate flight schools. The approach for this study was to see if there was a relationship with the level of SMS implementation, level of management commitment, and level of safety promotion and safety culture. There are four major scales within safety culture each having different subscales. Various levels of SMS implementation and safety promotion existed among the different flight schools, while the management commitment variable had less variability.

Conclusions

Research Question 1

The first research question was this: What is the relationship between SMS implementation and safety culture at collegiate flight schools? There was a positive relationship between SMS implementation and all of subscales within the Formal Safety Program major scale of safety culture. All four components except for Safety Risk Management had a positive statistically significant relationship with the three subscales within this major scale. Reporting System did not indicate a statistical significance with Safety Risk Management.

SMS is defined as a "the formal, top-down, organization-wide approach to managing safety risk and assuring the effectiveness of safety risk controls. It includes systematic procedures, practices, and policies for the management of safety risk" (FAA, 2015a). The formal organized

approach to managing safety that comes from SMS implementation seems to have an impact on the Formal Safety Program aspects of safety culture. The subscales Reporting System and Response and Feedback are linked to reporting culture and informed culture. Another aspect of reporting culture would be how many reports are filed at an individual institution. The majority of the respondents had never submitted a hazard report. The reporting results of this study were similar to those of Freiwald et al. (2013) and Adjekum et al. (2015) which suggested that generally the respondents thought that safety reporting systems were important but they did not participate in the safety reporting system at their organization. The relationship between Response and Feedback and SMS implementation suggests similar findings to those reported by Adjekum et al. (2015) in that when there is effective feedback on safety issues, a positive perception of safety culture is the result.

The Informal Safety Program had only one subscale, Accountability, that had a statistically significant positive relationship with every component except for Safety Policy. Accountability is linked to a just culture, which is an important aspect of achieving a strong safety culture.

Operations Interaction had one subscale, Dispatch, that was positively correlated with all four components. This result is similar to those of Adjekum (2013) that found that was a "good perception of the professional role of dispatch, which seem to have an effect on their authority to make informed and safe decisions on flight issues" (p. 111). The Instructor subscale had a relationship to Safety Assurance as well. This major scale takes into account the perception of how concerned they (dispatch, instructors, etc.) are for safety and their involvement in safety at the organization.

Safety Fundamentals was the only subscale within the major scale of Organizational Commitment that had a relationship to SMS implementation. Safety Fundamentals refers to the leadership's compliance with regulatory aspects of safety. This subscale may tend to have a positive relationship because SMS is not required for collegiate flight schools; therefore if a flight school is pursuing SMS they are probably meeting regulatory compliance in other areas.

Safety Behavior is not a major scale; however, behavior is an important aspect of safety culture. There was a negative relationship between Safety Behavior and every SMS component. However, none were statistically significant. It is unclear from this study as to why this negative relationship existed. One reason could be that within an organization that has a strong reporting culture and just culture, people feel more comfortable reporting their errors as well as the errors of others.

McNeely (2012) found that the implementation of SMS influences the safety culture of an organization in a positive way. Similar to McNeely, the results of this study indicate that there is a positive relationship between SMS implementation and safety culture within every major scale but more specifically the Formal Safety Program scale.

Research Question 2

The second research question was the following: What is the relationship between the level of promotion and the safety culture at collegiate flight schools? This question parallels question one, as Safety Promotion is a major component within SMS. Safety Promotion has a strong link to every other component within SMS. Similar to question one, the results of this study indicated a positive relationship between Safety Promotion and safety culture. The more promotion that is done within an organization the stronger is the safety culture for the Formal Safety Program major scale. All of the subscales within this major scale had a positive relationship with safety promotion.

The Informal Safety Program had only one subscale, Accountability, that had a statistically significant positive relationship with Safety Promotion. As previously mentioned, Operations Interaction had one subscale, Dispatch, that was positively correlated with Safety Promotion. Safety Fundamentals was the only subscale within the major scale of Organizational Commitment that had a relationship to Safety Promotion. The safety manager from each institution answered a question rating the level of promotion on a scale from 0 to 10. The responses from this question were not included in the analysis due to their being only one individual's opinion as to the rating of promotion. However, the ratings that the safety officer gave for promotion seemed to parallel the statistical relationship with SMS implementation that was found for each school.

Research Question 3

The third research question was the following: What is the relationship between the level of management commitment and safety culture at collegiate flight schools? The relationship between management commitment and safety culture was similar to the previous two research questions. All of the subscales within Formal Safety Program were positive and significant, as well as Accountability, Dispatch, and Safety Fundamentals. There was an additional subscale that had a significant and positive relationship, which was Supervisor of Flight/Chief Flight Instructor. Chief flight instructors in most flight training organizations are considered management. If there is more management commitment to SMS implementation, then the Operation Interaction of the Chief Flight Instructor would be perceived more positive by the respondents. The safety manager from each institution answered a question rating the level of management commitment on a scale from 0 to 10. The responses from this question were not included in the analysis due to their being only one individual's opinion as to the rating of management commitment. However, the ratings that the safety officer gave for management commitment seemed to parallel the level of SMS implementation that was found for each school.

Recommendations

Safety culture is dynamic within all organizations. The assessment of safety culture requires baseline measurements for comparison as procedures, policies, and people evolve over time. Safety staff and management must continually review the effectiveness of their SMS and one way to achieve this is through safety culture assessment.

The findings of this study indicate that there is a relationship between SMS implementation and organizational safety culture. Management commitment and promotion were found to have a relationship with safety culture as well. The relationship seemed to be primarily focused on the Formal Safety Program major scale. The results emphasize the need for collegiate flight schools and other aspects of the industry to examine their level of SMS implementation, management commitment, and promotion to understand the safety culture of their organization. The better understanding about the relationship between these variables will equip organizations for developing the strongest safety culture possible. Currently, there is no guidance for the flight school community regarding SMS. Future studies could assist in determining the most important aspects of SMS for a future requirement for this population.

Future studies should be done to examine the relationship between SMS and safety culture in not only the collegiate environment but also other aspects of the industry. To gain a better understanding of this relationship, future studies would need to have a larger sample size and response rate. It was unclear from the results of this study as to which elements and processes had the strongest relationship to safety culture. Future studies need to be conducted to examine the specific elements and processes of SMS that have the greatest impact on safety culture. One particular school had a strong safety culture but did not have as many SMS elements and processes in place as some of the other schools with a weaker culture. Future studies need to investigate the other factors that may influence safety culture and safety behavior beyond the scope of SMS implementation.

The CAPSCUS is an extensive instrument with many questions that may affect the response rate. Future studies could use a shorter version of the CAPSCUS to help increase response rate without sacrificing a valid and reliable measurement of safety culture. To condense the CAPSCUS, more validity studies need to be done on the instrument. Future studies also need to be done to attempt to try and determine factors that affect or predict safety behavior of individuals within the organization. Specific subscales were found to have a statistically significant relationship to the SMS components, management commitment, and safety promotion. Future studies should investigate this phenomenon and gain a better understanding through qualitative assessment. Qualitative studies will help researchers gain a better understanding of safety culture perceptions, attitudes, and behaviors and their relationship to SMS.

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