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Organizational Safety Culture in Pilot Training Schools: Case of North Texas in the USA and South Korea

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Abstract

The sudden increased need for qualified pilots can cause potential risks for aviation training schools in South Korea because new pilot training programs need to be created, or existing organizations need to be expanded quickly. This study investigates safety culture at pilot training schools, builds a conceptual framework, and identifies the relationship between the sub-safety culture category and safety culture level in commercial pilot training schools. The authors survey the safety culture and management for the organizational aspect of these pilot training schools to clarify essential concepts and generate a conceptual safety management model. The authors examine the differences in safety culture between pilot training schools in the USA and South Korea and the effects these differences have on the organizations. Results show that the safety culture between pilot training schools in north Texas in the USA and South Korea is different. A pilot training school has to have a well-defined safety culture and management procedures in place and an awareness of the diverse cultural backgrounds of its student pilots to avoid potential cultural clashes and needless accidents/incidents.

Keywords: safety culture, cultural clash, safety management system, human factor, organization culture

1. Introduction

Boeing (2019) forecasts air passenger growth of 4.6% and fleet growth of 3.4% per year within the 20 years between 2019 to 2038. It is estimated that the worldwide number of commercially operated aircraft will jump from about 23,480 in 2015 to 46,950 in 2036 (Boeing, 2015). A survey by the International Civil Aviation Organization (ICAO) indicates a potential global shortage of 330,306 pilots from 289,362 in 2016 to 619,668 in 2036 (Vreedenburg, 2018). The rapid economic growth in the commercial aviation industry increases the demand for more pilots, though challenges make it difficult to meet the demand quickly; it takes several years to earn a pilot certificate, and training costs are increasing. The aviation community must ensure that there are enough qualified aviation professionals in every region of the world to support this growth. Substantial economic growth in China has increased demand for commercial pilots in the region (Boeing, 2015), especially in China, South Korea, and the Middle East. This region will need 3.6 times the number of new pilots in 2036 than in 2016 (Boeing, 2015).

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The increased need for qualified pilots in Asia can cause potential operational risks. New pilot training organizations need to be established or existing organizations need to be expanded quickly to meet the demand for pilots and ensure a safe environment (FlightGlobal, 2017) with the influx of new pilots during a short time period.

In an attempt to meet this growing demand for commercial pilots and to address the shortage of South Korean pilots (Wong, 2016), the South Korean Government sanctioned the establishment of approved training organizations (ATOs) in July 2010 (Hong et al., 2016), and 11 ATOs were established from 2010 to 2014. The rapid increase in demand during a short time period for pilots in South Korea will lead to operational risks in civil pilot training schools (Yim, 2017). For example, in 2011, a newly opened ATO in Korea experienced a fatal accident within its first year of operation, wherein two training aircraft collided in mid-air (AviationSafety Network, 2021). Likewise, in 2013, an accident occurred in the same organization that resulted in three fatalities, including an instructor (Hong et al., 2016). In 2016, another ATO had an accident on its runway, which resulted in one fatality.

The shortage of pilot training schools in Korea has led to an increased number of Korean pilot candidates going to the USA. However, there is little research on the safety culture of pilot training schools in the USA. We focus on the safety culture of pilot training schools and compare the cultures of north Texas and South Korea. The focus of our research outlines this study's research framework (see Figure 1). The following section presents a review of the literature on organizational safety culture in commercial airlines and in pilot training schools. Section 3 discusses the data collection process, research methodology, and conceptual frameworks with hypotheses that address the characteristics of aviation safety culture and its differences between north Texas and South Korea. Section 4 presents the research results, discussion, and implications. Section 5 concludes with limitations and future research directions.

2. Literature Review

Human errors were the primary contributing factors in airline accidents in the last two years in the world (International Air Transport Association [IATA], 2021), and human error is the last link in the chain of accidents (Luchtvaartfeiten.nl, 2015). The policies in place for human errors should support and encourage organizational adaptation as well as a positive and open reporting culture (IATA, 2021). Cultures vary across nations and within cultures as well, forming subcultures (Helmreich & Merritt, 2001). Within cultures, norms can vary by demographic factors, such as age, education, and occupation (Schwartz, 1999). Even within an organization, different cultures exist and clash with each other when communications are vague, especially in high power distance and low individualism societies (Enomoto & Geisler, 2017). Therefore, organizations need to develop a clearer theoretical understanding of these organizational issues to create a basis for a more effective safety management system (SMS) (Chen & Chen, 2012) through culture-enhancing practices (Reason, 1998). A SMS strategy maintains the evolution and continuous improvement of safety culture (IATA, 2021). This approach extends the scope of accident analysis from individuals to an organizational safety culture. The following sections review the literature on safety culture for commercial airlines (Section 2.1) and pilot training schools (Section 2.2).

2.1 Safety Culture in Commercial Airlines

All airlines have unique operational situations, including the age of the fleet, economic situation, dominant culture of the organization, and region in which it operates. Organizational culture can be delineated as collective behaviors in specific organizations that are perceived as the values and ways of interacting within the organization (Lumpe, 2008). By focusing on the identification and analysis of organizational culture, one may take corrective

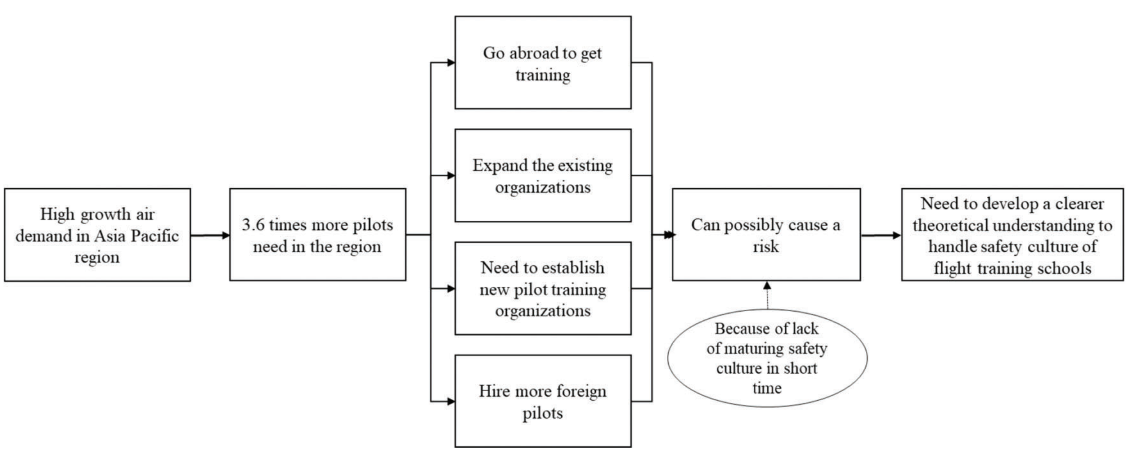

Figure 1. Research motivation.

action early to break the chain of events and prevent accidents (Reason, 1998). To access the organizational culture of an airline company, comprehensive data collection and analysis are needed, as well as the use of proactive analysis of airline safety in monitoring human-related safety factors (Braithwaite et al., 1998; Edkins, 1998; Maurino, 1999).

The airline safety level to be standardized is based on a comparative process that examines proactive safety measures among air transport companies and individual safety surveys to reach a safety culture score for the aviation organization. The safety level of an organization is a relative concept and is in accordance with the notion of competitiveness that incorporates three groups of measures (Buckley et al., 1988; Patankar & Sabin, 2010): (a) performance for representing the outcome of the safety effort, (b) potential for indicating capability to improve safety performance, and (c) process for reflecting the management of potential to achieve safety performance. The airline safety level implies that safety performance is measured by accident rates, incident rates, and safety efforts, as well as employee attitudes about a company's safety culture (Evans et al., 2007; ICAO, 2012). The proactive safety measures used to calculate an airline's safety level should ideally be risk-based and culture-based (Airbus, 2001). An immature safety culture can lead to inaccurate risk perceptions (Hong et al., 2022) of a pilot, which causes accidents through poor decision-making (Ji et al., 2018). The difference in national cultures in the workplace environment can affect individual attitudes, values, and team interactions in aviation organizations (Helmreich & Merritt, 2001). The cultural legacy could be a factor in accidents (Helmreich & Merritt, 2001), cockpit communications (Gladwell, 2008), and aircraft crashes that result from bad weather, pilot fatigue, and combinations of factors. The cultural clash between different cultural background operators can be a related factor in an accident, such as the accidents of the late 1990s in Korea (Hong, 2003).

2.2 Safety Culture in Pilot Training Schools

Safety culture is the core value of a healthy organization that is operating in a high-risk environment, and it includes the beliefs, attitudes, and values of the employees and management within an organization (Reason & Hobbs, 2003; You et al., 2013). The importance of training pilots regarding safety culture cannot be overemphasized because the success of SMS initiatives in collegiate aviation programs is strongly influenced by the safety culture of the programs' front-line personnel, including certified instructors and students (Adjekum, 2014; Im et al., 2021). Implementing a SMS and sustaining a positive safety culture in a collegiate aviation program can generate both economic and operational benefits (Lercel et al., 2011). However, the nonuniformity of training and the nonmatured safety culture of a newly established pilot training school in South Korea raise questions about whether different safety levels exist among the various training institutions (Hong et al., 2016; Im et al., 2021). Flight training programs must promote error avoidance, assist in the early detection of pilot errors, and minimize the consequences of errors when they occur (Salas et al., 2001). This type of training focuses on the effects of pilots' negligence and unsafe behaviors in a complex system (Reason, 1990), on mutual relationships (Cooper, 2000), and within the human-error framework (i.e., the human factors analysis and classification system) proposed by Weigmann and Shappell (2003). Student pilots lack confidence concerning their knowledge during flight operations; moreover, they may fail to recognize the importance of maintaining relationships among supporting staff, such as air traffic controllers, mechanics, and others involved in the flight process (Hong et al., 2016). Each pilot training school has its curricula, methods, equipment, and tools certified by the civil aviation authority of South Korea. Newly approved aviation programs and the quick expansion of existing aviation academies are needed to meet the growing demand for pilots in South Korea. These new and expanded academies provide essential training from the very beginning of pilot training. There are also significant differences in the perceptions of resident U.S. students and international contract students regarding the safety of programs (Adjekum, 2014).

Safety management. This includes organizational commitment (Wiegmann et al., 2002), which indicates that pilot training schools' management identifies safety as a core value or guiding principle of the organization. Aspects of safety culture are found in the visible commitment of senior management towards safety (Federal Aviation Administration [FAA], 2010; Gill & Shergill, 2004; ICAO, 2012), an enduring characteristic of an organization (Zhang et al., 2002), and is a core value of a being a healthy organization when dealing with a high-risk environment (Reason & Hobbs, 2003). Aviation organizations design SMSs to integrate safety policies and augment safety performances at organizational and individual levels (Chen & Chen, 2012). The actions and behaviors of the organization and individuals within an organization will always be threats to safety; therefore, an essential component of ensuring safety is identifying and managing potential threats before accidents occur (FAA, 2010; Gill & Shergill, 2004).

Safety procedures. Human behavior is continually affected by culture, peer pressure, environment, physical condition, training education, level of satisfaction, personal beliefs, etc. (Orlady and Orlady, 1999; Peterson, 2001). Employee empowerment (Wiegmann et al., 2002), training, and self-decision-making (Gill & Shergill, 2004) are based on various factors that occur at any time. Employees have an influential voice in safety decisions, have the leverage to initiate and achieve safety improvements, hold themselves and others accountable for their actions, and take pride in the safety record of their organization (Wiegmann et al., 2002).

Organizational culture. The culture in aviation training schools is essential because it reflects how flight management and training departments establish, direct, and oversee flight operations (Degani & Wiener, 1993). Aspects of safety culture are found in the shared attitudes of care and concern throughout an organization (Pidgeon & O'Leary, 1995). It is also located in an environment that thrives on sharing vital information (informed culture), where employees are prepared to report their errors and near misses (reporting culture) and have the trust that they will be treated fairly (just culture) (Reason, 1998; Reason & Hobbs, 2003). The organizational safety culture can include a reward system from top to bottom and a reporting system from bottom to top with employee empowerment (Wiegmann et al., 2002).

3. Research Methodology, Model, and Hypotheses

The following procedures were used to develop our framework on safety culture for civil pilot training schools: (1) review literature on safety culture for aviation organizations and pilot training schools, (2) specify survey questionnaire items based on the literature review, (3) collect data at two pilot training schools in South Korea and three in the north Texas area, (4) conduct normality, homoscedastic, and nonresponse bias test for collected data, (5) apply exploratory factor analysis and reliability test, (6) set hypotheses and research model, (7) apply confirmatory factor analysis (structural equation model), and (8) verify hypotheses.

3.1 Survey Questionnaire and Data Collection

We reviewed the ICAO (2018) *Safety Management Manual*, the FAA (2010) *Introduction to Safety Management Systems for Air Operators*, the Airbus (2001) *Operator's Flight Safety Handbook*, and Transport Canada (2008) *Safety Culture Checklist* to gather information for an objective questionnaire. Some of these attributes are qualitative measures, which require subjective assessments by human experts. Multi-attribute decision-making has proven to be a practical approach for ranking a finite number of alternatives characterized by multiple safety culture attributes (Hong & Kim, 2006; Kim et al., 2005). The design of the questionnaire for this study mostly follows the Airbus *Operator's Flight Safety Handbook* to measure the perception of safety culture levels in pilot training schools and to find an attributable factor for organizational culture. We found the variables related to safety culture and applied them to the pilot training schools' approach to safety management, decision-making, and safety responsibilities of individuals. The questionnaire uses a 5-point Likert scale where 1 = strongly disagree and 5 = strongly agree.

The questionnaire consists of two segments. The first section includes questions regarding respondents' sociodemographic traits, including work areas in the aviation field such as safety department, pilot, operations control, years of experience in the civil aviation industry, training, and military experience in a similar position. The second segment evaluates the awareness of the safety culture of the organization where the respondents work or receive training with 25 safety culture-related constructs from C1 to C25 (see Table 1). The survey was conducted from March to June 2018 for two pilot training schools in South Korea and three schools in the north Texas area, including one collegiate flight program in each country. The survey included instructors, air traffic controllers, maintenance, and safety-related officers at the schools (see Table 2). All five schools are FAA part 141 flight training schools and equivalent schools in South Korea with 100 to 300 pilot training students. Our sample consists of responses from two groups; 259 responses were received from five pilot training schools: (1) 120 responses from north Texas (46.3%), the state of Texas, and (2) 139 responses from South Korea (53.7%).

3.2 Tests and Exploratory Factor and Confirmatory Factor Analyses

Normality, homoscedastic, and nonresponse bias tests. All analyses have been subject to bootstrap analysis with 5,000 bootstrap samples due to the nonnormality of all dataset variables (based on the Shapiro–Wilk test) and heteroscedastic (standardized residual variables between safety level of an organization and attributes [based on Levene's test]) using SPSS 27. To test nonresponse bias, the *t*-test bootstrap was used to examine the significant difference between respondents of various time waves (Armstrong & Overton, 1977). We received the samples from two different time waves with a four-month difference; we collected 105 samples in the first wave and 154 samples in the second wave. The *t*-test results showed no statistically significant differences between the two groups; only five variables (C3, C5, C13, C14, and C23) out of 25 variables are significant with p level of 0.05, which means that our data show minimal nonresponse bias.

Exploratory factor analysis and reliability test. We extracted the components using exploratory factor analysis. Based on the principal axis factoring, 55.5% of the total variance in the items can be explained by the three extracted principal components, which have at least three items using the varimax rotated component matrix with

Table 1
Descriptive statistics for constructs of organizational safety culture.

#	Constructs	South Korea [1] (n = 139)		North Texas [2] (n = 120)		Mean difference [1] − [2]
		Mean	Std dev.	Mean	Std dev.	
C1	Employees are given enough training to do their tasks safely	4.24	0.711	4.32	0.788	−0.072
C2	Managers get personally involved in safety enhancement activities	3.98	0.829	4.00	0.987	−0.022
C3	There are procedures to follow in the event of an emergency in my work area	4.21	0.727	4.11	0.877	0.098
C4	Managers often discuss safety issues with employees	3.92	0.869	4.01	0.993	−0.092
C5	Employees do all they can to prevent accidents	3.91	0.928	3.80	0.984	0.118
C6	Everyone is given sufficient opportunity to make suggestions regarding safety issues	3.81	0.975	3.63	1.060	0.184
C7	Employees often encourage each other to work safely	4.14	0.791	4.25	0.820	−0.113
C8	Managers are aware of the main safety problems in the workplace	4.09	0.824	4.11	0.997	−0.015
C9	All new employees are provided with sufficient safety training before commencing work	4.02	0.897	3.73	1.079	0.292*
C10	Managers often praise employees they see working safely	3.83	1.019	3.70	1.149	0.140
C11	Everyone is kept informed of any changes that may affect safety	3.76	0.939	3.52	1.055	0.237
C12	Employees follow safety rules almost all of the time	4.09	0.824	3.93	0.921	0.160
C13	Safety within this company is better than in other airlines	4.11	0.998	3.90	0.966	0.204
C14	Managers do all they can to prevent accidents	3.86	1.025	3.15	1.228	0.702***
C15	Accident investigations attempt to find the real cause of accidents, rather than just blame the people involved	3.75	1.064	3.74	1.115	0.013
C16	Managers recognize when employees are working unsafely	3.78	0.915	3.45	0.968	0.330**
C17	Any defects or hazards that are reported are rectified promptly	3.98	0.928	3.80	0.976	0.183
C18	There are mechanisms in place in my work area for me to report safety deficiencies	4.32	0.754	4.53	0.788	−0.210*
C19	Managers stop unsafe operations or activities	3.99	0.897	3.67	1.001	0.325**
C20	After an accident has occurred, appropriate actions are usually taken to reduce the chance of reoccurrence	4.21	0.756	4.11	0.924	0.100
C21	Everyone is given sufficient feedback regarding this company's safety performance	4.12	0.817	4.11	0.888	0.003
C22	Managers regard safety to be a very important part of all work activities	4.15	0.859	4.00	1.054	0.147
C23	Safety audits are carried out frequently	4.32	0.810	3.93	1.032	0.395**
C24	Safety within this company is generally well controlled	4.19	0.721	3.92	1.007	0.278*
C25	Employees usually report any dangerous work practices they see	4.03	0.932	4.08	1.086	−0.046

***Significant at 0.001. **Significant at 0.01. *Significant at 0.05.

Table 2
Descriptive statistics for respondents.

Affiliation	#	%	Category of employment	#	%	Years employed	#	%
Pilot training schools in South Korea	139	53.7	Safety	35	13.6	<5 years	124	47.9
			Pilot	169	65.5	6–10 years	22	8.5
Pilot training schools in north Texas	120	46.3	Operation control (including air traffic controller of the pilot training schools)	26	10.1	11–15 years	27	10.4
			Maintenance	18	7.0	>16 years	86	33.2
			Other	10	3.9			
Total	259	100	Total	258	100	Total	259	100

Kaiser normalization. Rotation converged in 14 iterations. The KMO and Bartlett's test (0.945 and approx. χ^2: 3429.86 [sig. = 0.000]) are significant statistically (see Table 3). Cronbach's alpha (α) is above 0.700, which is statistically significant.

Confirmatory factor analysis. Based on the literature review in Section 2 and from the exploratory factor analysis result, we obtained a research model with three latent variables: safety management for management commitment and involvement; safety procedure for reports and employee empowerment; and organization culture for learning culture. The selected constructs and latent variables were evaluated through confirmatory analysis using SPSS AMOS (Analysis of Moment Structures) version 27. We applied the traditional confirmatory factor analysis for validation of the three latent variables using each item as a separate indicator of the relevant construct, thus providing a detailed level of analysis. The confirmatory factor analysis for the safety culture model (see Table 4), the model for pilot training schools in north Texas, and the model for pilot training schools in

Table 3
Results of exploratory factor analysis.

Latent variables	**#**	**Components**			**Reliability test**
		1	**2**	**3**	
Safety management	C10	**.603**	.270	.328	Cronbach's α = 0.805
	C15	**.625**	.182	.343	
	C17	**.667**	.176	.343	
	C19	**.691**	.324	.330	
	C20	**.650**	.296	.249	
	C22	**.709**	.231	.161	
	C24	**.607**	.494	.228	
Safety procedure	C1	.422	**.602**	.061	0.835
	C3	.356	**.608**	.009	
	C18	.056	**.757**	.179	
	C25	.308	**.647**	.311	
Organization culture	C5	.197	.073	**.718**	0.751
	C6	.213	.397	**.691**	
	C11	.365	.320	**.621**	
	C12	.179	.252	**.684**	
Extraction sums of squared loading (%)		45.01	5.79	4.72	55.52[a]
KMO and Bartlett's test		0.945 and χ^2: 3429.86 (0.000***)			

Note. Extraction method: principal component analysis. Rotation method: varimax with Kaiser normalization. Rotation converged in 14 iterations.
[a]Total extraction sums of squared loading (%).
***Significant at 0.001.

South Korea evaluated and accepted the models significantly as an excellent or acceptable fit based on Hu and Bentler's (1999) criteria.

3.3 Research Models and Hypotheses

Study 1—The safety culture framework. Based on the previous section with the results of the exploratory factor analysis and confirmatory factor analysis, the research model is acceptable to use for the organizational safety culture framework using structural equation model (see 2">Figure 2). We use the three research attributes to measure the safety culture at five pilot training schools: (1) safety management, (2) safety procedure, and (3) organizational culture. Therefore, we posit the following hypothesis:

H_1: The three variables (safety management, safety procedure, and organizational culture) positively correlate with the safety culture level in a pilot training school.

Study 2—The perception of standardized safety cultural variables between pilot training schools in north Texas and South Korea. Hofstede (2001) analyzed how cultures, behaviors, institutions, and organizations across nations differ from one another. Boeing (1993) published safety data in its *Accident Prevention Strategies: Removing Links in the Accident Chain*, showing a correlation between a country's plane crashes and its score on Hofstede's dimensions, but it practically tied itself in knots trying not to cause offense.[1] Hofstede's (2001) dimensions are among the most widely used paradigms in cross-cultural psychology (Gladwell, 2008; Merritt, 2000). Among Hofstede's dimensions, power distance and individualism were found to have a relationship to plane crashes (Enomoto & Geisler, 2017). Table 5 shows the difference in dimensions between north Texas and South Korea and the highest and lowest countries. With South Korea in northeastern Asia and the USA in the west, it is notable that both countries have very different sets of cultural values. The Power Distance Index expresses a culture's attitude towards inequalities among individuals (Minkov & Hofstede, 2014).

South Korea has a score of 60, a high level compared to the USA. Although a score of 60 is not extreme, Confucian South Korean culture leans more towards a hierarchical society, influencing the cockpit culture in South Korean pilot training schools. The first officer speaks using culturally accepted mitigated speech to show deference and respect to authority (Gladwell, 2008). The mitigated speech might provoke communication problems between the captain, first officer, flight engineer, and air traffic controllers (Enomoto & Geisler, 2017). According to Boeing's (1993) report, the high power distance countries had high rates of airline accidents, while countries with high individualism had lower accident rates. The Individualism Index of South Korea scored very low (18 versus 91 for the USA) and was negatively related to

[1] This study has been cited often, including by Gladwell (2008) and Enomoto and Geisler (2017).

Table 4
Results of confirmatory factor analysis for safety culture model at pilot training schools.

Measure	Safety culture model		Safety culture model for the pilot training schools in north Texas		Safety culture model for the pilot training schools in South Korea		Threshold for excellent[a]
	Estimate	Interpretation	Estimate	Interpretation	Estimate	Interpretation	
CMIN	130.999	—	123.890	—	125.759	—	—
DF	82	—	82	—	82	—	—
CMIN/DF	1.598	Excellent	1.511	Excellent	1.534	Excellent	Between 1 and 3
CFI	0.973	Excellent	0.949	Acceptable	0.961	Excellent	>0.95 (<0.95[b])
SRMR	0.041	Excellent	0.064	Excellent	0.049	Excellent	<0.08
RMSEA	0.048	Excellent	0.066	Acceptable	0.062	Acceptable	<0.06 (>0.06[b])
PClose	0.563	Excellent	0.141	Excellent	0.174	Excellent	>0.05

Note. CMIN, Chi-square value; DF, Degree of Freedom; CFI, comparative fit index; SRMR, standardized root mean square residual; RMSEA, root mean square error of approximation; PClose, *p* of close fit.
[a]Source: Hu & Bentler (1999).
[b]Threshold for acceptable.

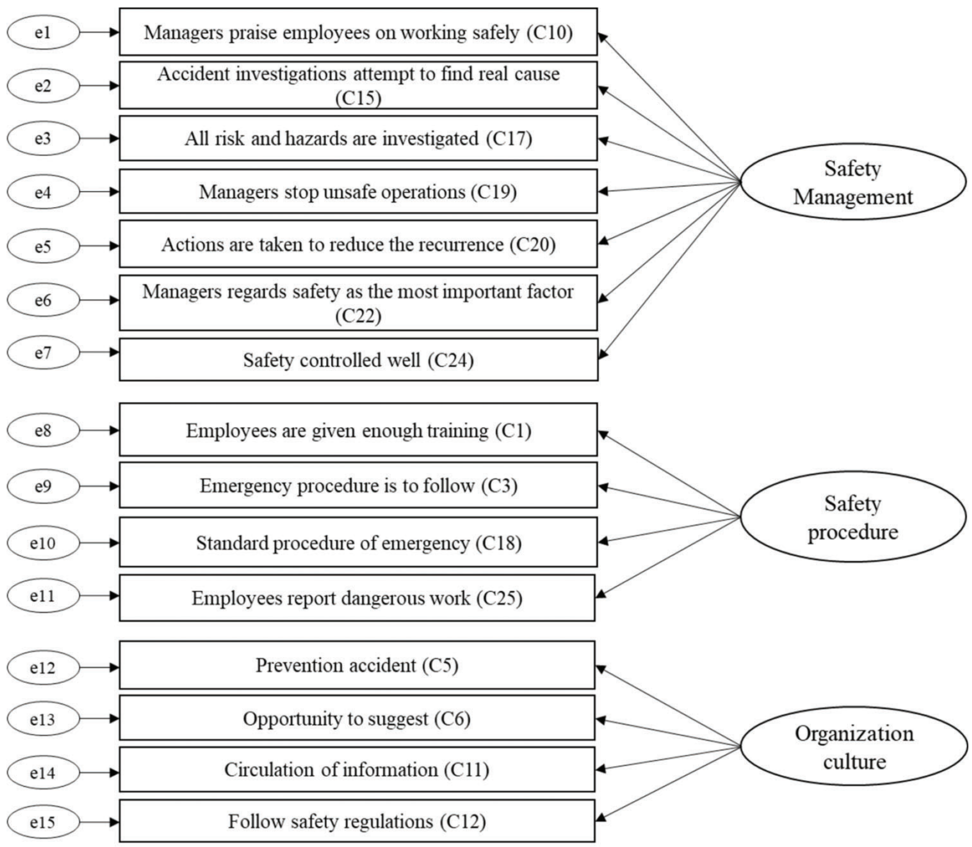

Figure 2. Research model for safety culture within an organization.

plane accidents (Enomoto & Geisler, 2017). Low individualism–high collectivism and high power distance cultures might impede communication and teamwork to stop a chain of errors.

Even though culture is inherited, economic development, globalization, and social exchanges homogenize a culture. Culture clashes still exist and may impact accidents. Accordingly, a regulator's contribution and involvement are imperative to minimize the organizational safety culture in accident causation, especially for a newly established pilot training school or expanding an organization when quickly faced with pilot demands. The FAA (2010), ICAO (2018), Transport Canada (2008), and Airbus (2001) have established a comprehensive and integrated procedure to encompass a standardized safety management procedure to handle the issue of safety culture and SMSs for aviation communities. Therefore, we set the second hypothesis to examine how pilots-in-training perceive the standardized

Table 5
Comparison of culture index between the USA and South Korea as well as highest and lowest country.

Cultural classification	USA		South Korea		Highest country			Lowest country		
	Score	Rank	Score	Rank	Country	Score	Rank	Country	Score	Rank
Power distance	40	57/59	60	41/42	Malaysia	104	1	Austria	11	74
Uncertainty avoidance	46	62	85	23/25	Greece	112	1	Singapore	8	74
Individualism	91	1	18	63	USA	91	1	Guatemala	8	74
Masculinity	62	19	39	59	Slovakia	110	1	Sweden	5	74
Long-term orientation	31	32/33	75	6	China	118	1	Pakistan	0	39

Source: Hofstede and Hofstede (2005).

safety variables in safety cultures between the pilot training schools in north Texas and South Korea. We posit:

- *H_2*: The same perceptions on sub-safety culture variables exist in pilot training schools between North Texas and South Korea.
- *$H_{2\text{-}1}$*: The safety commitment of top management has the same perception in pilot training schools between North Texas and South Korea.
- *$H_{2\text{-}2}$*: The safety commitment of top management has the same perception in pilot training schools between North Texas and South Korea.
- *$H_{2\text{-}3}$*: The organizational culture has the same perception in pilot training schools between North Texas and South Korea.

4. Results of the Hypotheses Analysis, Discussion, and Implications

Our findings indicate that the three variables—safety management, safety procedure, and organizational culture—have a positive relationship with the safety culture level (see Table 6 and Figure 2) based on all of the respondents' survey results. Thus, the model with the three variables can be used to improve and reinforce the safety culture for a pilot training school. $\mathbf{H_1}$ is statistically significant and supported for the safety culture framework for the organizational aspect of a pilot training school. However, when we separate the samples into two groups ($\mathbf{H_2}$), such as pilot training chools in north Texas and South Korea, we have different outcomes. The attribute of safety commitment of management has the same perception for the pilot training schools in north Texas and South Korea, supporting $\mathbf{H_{2\text{-}1}}$, and has a positive relationship with the safety culture level for north Texas and South Korea. With safety procedures and organizational culture showing different perceptions, it does not support $\mathbf{H_{2\text{-}2}}$ and $\mathbf{H_{2\text{-}3}}$, but it has a positive relationship with the safety culture level for north Texas. The relationships between safety procedure and organizational culture are not perceived as safety culture level for South Korea (see Figure 3 and Table 7). Thus, we find different perceptions of safety culture attributes in the two pilot training schools in north Texas and South Korea, and $\mathbf{H_2}$ is not supported. Even though the pilot training schools are located in countries with diverse cultural backgrounds, they have to focus on the nationality of the trainees to understand the appropriate safety culture for their aviation operations. However, the results show differently.

As previously noted, all aviation training schools have their unique operational situations, including the age of the fleet, state of equipment, capabilities of corporate structure, and factors specific to pilots such as age, experience, gender (McFadden, 1996), pilot salary (Low and Yang, 2019), and personality traits that have been linked to pilot-error accidents (McFadden, 2003; McFadden and Towell, 1999) and recruiting procedures. As such, a pilot training school also has its internal situations that impact its safety culture. Any safety initiative can have an unequal effect on the aviation organization and become an issue to be promoted or fought depending on each organization's status, leading it to seek the path that best suits its organization's goals.

Generalizing the cultural or organizational factors that contribute to accidents is complicated. However, Gladwell (2008) noted that hierarchical national cultures that are influenced by Confucian ideas might be a factor in the Korean Airlines accidents of the late 1990s. Hong's (2002) analysis of aviation accidents suggested culture clashes (or subculture clashes) as a possible cause of the accidents. Hierarchical national cultures mean that the less experienced defer to older, more experienced leaders. The psychic cost of more direct communication is high to a junior co-pilot, whereas, in low power distance countries, the psychic cost of direct communication is much lower (Enomoto & Geisler, 2017). Western communications are transmitter-oriented; it is the obligation of the speaker to communicate ideas. Like many Asian countries, South Korea is receiver-oriented, where it is up to the listener to make sense of what is being said (Gladwell, 2008). This study finds that pilots and other employees of the pilot training school in South Korea are not perceived to place high importance on safety procedures ($\mathbf{H_{2\text{-}2}}$) and organizational safety culture ($\mathbf{H_{2\text{-}3}}$). A considerable disagreement exists among safety professionals within an organization as to how safety culture should be defined and

Table 6
Results of structural equation model for safety cultural factors and safety culture level.

Research path	Coefficients and hypotheses for safety culture model (H_1)	
SM SCL	11.290***	Supported
SP SCL	8.817***	Supported
OC SCL	4.961***	Supported
Goodness of fit	Estimate	Interpretation
χ^2/df	2.019	Excellent
CFI	0.966	Excellent
SRMR	0.051	Excellent
RMSEA	0.063	Acceptable[a]
PClose	0.053	Excellent

Note. SCL, safety culture level; SM, safety management; SP, safety procedure; OC, organizational culture.
[a]See Table 4 for the threshold for excellent.
***Significant at 0.001.

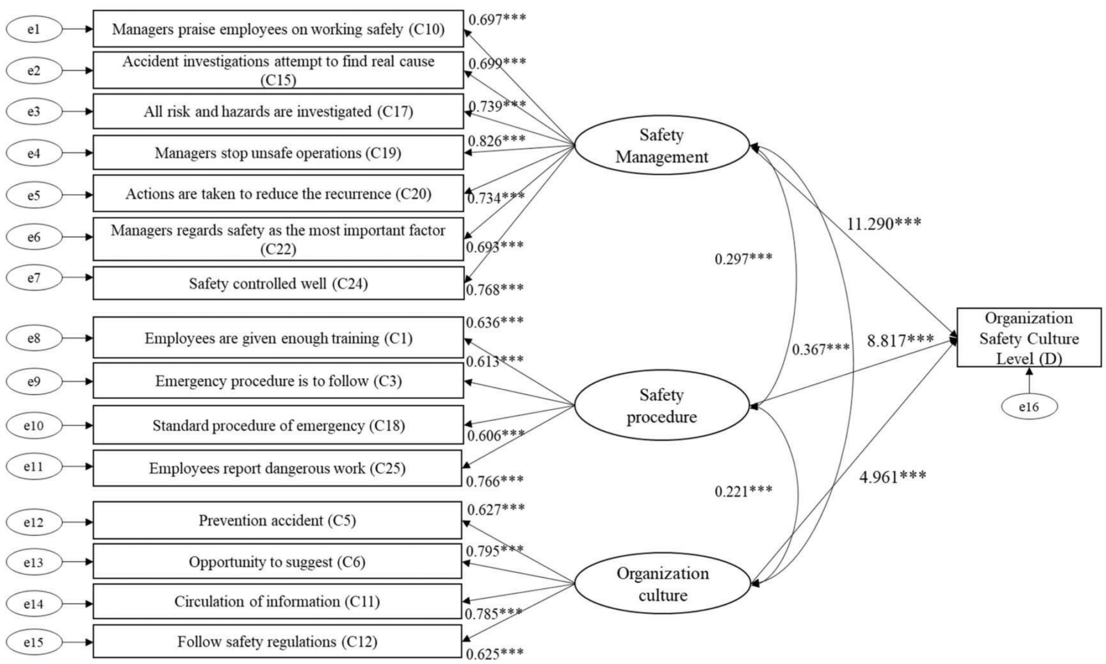

Figure 3. Structural equation model and hypotheses for safety culture within a pilot training school (standardized regression weight of each item and covariance of research attributes from combined north Texas and South Korea).

a perceived lack of focus on safety culture, which is inherently different from other safety climates.

Aviation industry workers have an excellent opportunity to become employed in a multicultural working environment because many of them have diverse, multicultural backgrounds, and airlines hire crew members of different nationalities in order to provide appropriate services in various countries (Liao, 2015) for ground and cabin crew. Therefore, an aviation training program or organization must have well-defined safety and management procedures, especially for new pilots who receive training from institutions with different cultural environments that could potentially cause a cultural clash. In the cockpit, cultural differences have an essential effect on the safety culture in the aviation industry (Gladwell, 2008; Hong, 2002; Liao, 2015). Economic development also has a powerful impact on cultural values (Inglehart, 2000), and culture influences economic development and competitiveness (Porter, 2000). Culture tends to homogenize, however, making it easier for countries to overcome cultural and geographic disadvantages (Porter, 2000). A safety culture cannot be created overnight; thus, changing mindsets and behavioral norms takes some time and requires continuous communication among members (Lu et al., 2010). Furthermore, training in two different countries could make it difficult for adaptation because national culture influences pilots' behavior patterns, especially for beginners who have never had aviation experience.

Table 7
Results of structural equation model for safety cultural factors and safety culture level.

Research path for H_2	Sub-hypotheses	Coefficients and hypotheses: Safety culture model for pilot training schools in north Texas		Coefficients and hypotheses: Safety culture model for pilot training school in South Korea		Decision for H_{2-x}	Remarks
Safety management	**H_{2-1}**	11.870***		11.101***		Same perception, supports **H_{2-1}**	Positive relationship
Safety procedure	**H_{2-2}**	7.505***		12.494		Different perception, not supported **H_{2-1}**	Positive relationship for north Texas, and not a positive relationship for South Korea
Organizational culture	**H_{2-3}**	4.576***		2.965		Different perception, not supported **H_{2-1}**	Positive relationship for north Texas, and not a positive relationship for South Korea
Goodness of fit		Estimate	Interpretation	Estimate	Interpretation	Threshold for excellent	—
χ^2/df		1.576	Excellent	1.752	Excellent	See Table 4	
CFI		0.956	Excellent	0.959	Excellent		
SRMR		0.070	Excellent	0.059	Excellent		
RMSEA		0.070	Acceptable	0.074	Acceptable		
PClose		0.074	Excellent	0.023	Acceptable		

***Significant at 0.001.

5. Conclusion with Limitations and Future Research Directions

This study proposes a new approach for studying safety culture and the different perceptions of safety culture in aviation training schools. The rapid expansion of air travel in the northeast Asian region, especially Korea, has created many new challenges for airline safety. This study identifies and analyzes relevant factors associated with safety culture for pilot training schools. Pilot training school managers and others will find this information useful as it helps to reduce risks inherent in training new pilots, especially international students. The framework of safety culture presented in this study provides safety experts with a tool to measure pilot training schools' safety culture level, be aware of the cultural differences of pilots and management, and take appropriate steps to avoid future accidents or incidents.

The outcomes of the framework are an integration of safety systems and a positive safety culture within a pilot training school. Human operators are considered an essential component within a system and are vital to the success of a safety framework. Emphasizing safety culture and perceiving the cultural differences during training, especially in pilot training schools in Korea, should lead to positive changes in the safety cultures of airline companies that will hire these newly trained pilots. A company's culture (Gladwell, 2008) and individual cultural clashes (Hong, 2003) can be factored in accidents and have to be minimized through meticulous training from the early career of the flight crew. Therefore, even though pilot training schools may differ in their internal organizational structure, safety procedures, work rules, and corporate environment regarding overall safety, a type-specific framework for assessing safety culture in the aviation academy should be investigated. There are also significant differences in the perceptions of safety culture in pilot training schools. Aviation academies with students from diverse cultural backgrounds should ensure that pilots are trained to recognize cultural differences that affect safety operations behavior, especially the nontechnical or social–psychological skills that pilots require during flights.

Future research should examine the effect of cultural clashes on safety culture and its relationship with accidents. Also, subsequent studies should identify factors associated with the safety culture of multiple pilot training schools in different countries and regions.

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