__Original Research Article__

Factors affecting safety courtesy behavior among Thai flight crews: construct validity and structural regression analysis

Abstract

Previous research indicates that safety climate has a significant impact on safety-related behaviors in a variety of circumstances; however, few researchers have examined at how safety climate affects safety courtesy behaviors among flight crews. The purpose of this study was to investigate the elements connecting to safety courtesy behaviors in Thai flight crews context using confirmatory factor analysis and structural equation modeling technique on 590 Thai flight crew samples. The results confirmed that the fleet safety climate had a favorableinfluence on flight crew safety courtesy behaviors via an increase in their safety knowledge and safety behavior. Furthermore, the direct, indirect, and total effects of fleet safety climate on safety courtesy via safety knowledge and safety motivation were significant. According to the findings, even in the Thai flight crews setting, a positive fleet safety climate, along with positive safety knowledge and positive safety motivation, can lead to desirable safety courtesy conduct. As a result, airlines should stress these elements and promote fleet-wide safety policies to encourage positive safety courtesy behavior among flight crews members. Future research should expand on the findings of this study by conducting additional multi-level analyses or use qualitative methods to delve into deeper results.

Keywords: aviation; construct validity; flight crews; safety courtesy; structural regression analysis

1.Introduction

In this high-reliability industry, air transportation safety has always been recognized as the top concern. In fact, flight crews safety-related behaviors are regarded as major determinants of air transportation safety performance. Flight crews, according to previous studies, are accountable for the overall safety of the flight operations.

Regrettably, they are also the leading cause of aviation mishaps. Although a variety of crew members play crucial roles in maintaining operational safety, flight crews are directly responsible for the safety of their passengers (1). Air mishaps are exceedingly infrequent, but when they do happen, they result in significant losses of property and lives. As a result, it's critical to learn more about the elements that influence flight crew safety behaviors, as well as to answer the question, "What could possible improve flight crew safety behaviors?"

This study draws attention to the role of fleet safety climate because, in aviation context, fleets of aircraft supply an important proximal work environment in which flight crews operate (2,3). Flight crews in the same fleets are trained to fly the same types of planes and follow the same operational and safety protocols. As a result, the same safety standards that are prevalent in their fleets are likely to impact them(4). Flight crews communicate and share operational information with colleagues in the same fleets on an individual level, and their work behaviors are likely to be influenced by their relationships with others (5).

To describe the positive influence of fleet safety climate, this study examines the mediating roles of safety knowledge and safety motivation (6,7). Furthermore, this study suggests that safety knowledge can be instilled in flight crews through a social learning process. That is, it is expected that flight crews will be exposed to a high level of safety attention through the socialization process of the work environment, which influences their knowledge and behavior, as a result of a strong safety atmosphere within fleets. It's also likely that a favorable fleet safety climate may boost employees' safety awareness and motivation, resulting in better adherence to safety procedures. (8).

The goal of this research is to gain a better understanding of the elements that influence safety courtesy behavior among Thai flight crews. Several quantitative techniques, including confirmatory factor analysis and structural equation modeling, will be examined as a result of knowing those factors. In various ways, this study adds to the body of knowledge on behavioral safety. For starters, even if prior studies had demonstrated the role of fleet safety climate in other critical scenarios, the importance of fleets safety climate in aviation has been negated. Secondly, only a few studies to date have scrutinized how and why fleet safety climate can have an influence on flight crews safety courtesy behaviors.

2.Literature Review

Social Learning Theory

Several past studies suggest that there is a positive relationship between the social environment and human behavior(9,10). This study also proposes that safety climate presents an important environment that can possibly determine safety behaviors(11,12). Human behavior is also explained by social learning theory in terms of reciprocal activities between cognitive, behavioral, and environmental elements. Individuals' behaviour is shaped,in particular,by their social environment, which is reinforced by incentives or punishments. When those in a social setting are thought to be personally significant to individuals, their influence grows. For example, if the social environment is characterized by people who prioritize safety, it is likely that employees will also adapt such behaviors. Furthermore, from the motivation aspect, the influence of the role models can help enhance self-efficacy in how to perform work as they learn from observing how others act accordingly (13).

Fleet Safety Climate and Safety Behavior

Safety climate is an environment-level factor, which can be divided into the group and organizational levels. In this study, group-level safety climate will be regarded as fleet safety climate. Fleet safety climate is defined as the shared perceptions about safety practice among members within the same fleets (14). In accordance with social learning theory aforementioned, this is considered as the most essential factors influencing safety behaviors(15). At the fleet level, the fleet safety climate can have a substantial impact on flight crew dedication to safety goals. Flight crew personnel in the same fleet are operationally trained to fly the aircrafts that they are assigned to fly. They are trained in this context to apply the same standard operating procedures and to rely on the same technical expertise, norms, and regulations. As a result, they are more likely to be impacted by the same fleet operational norms, therefore it is realistic to expect major differences in safety levels amongst fleets. Moreover, in this study, the primary focus is on safety behaviors which is considered as safety courtesy. Safety courtesy involves positive helping and participating behavior in activities among employee about safety-related issues at work and the willingness to join a safety-related promotional program (19–21). Safer flight operations can be predicted if employees work together to achieve higher levels of safety at work, such as good Crew Resource Management (CRM) and constructive interactions (19). As a result, safety courtesy has been seen as a type of citizenship conduct that goes above and beyond the call of duty and is not rewarded formally (20). Based upon the arguments and empirical evidence discussed, this study posits that fleet safety climate can exert positive effects on flight crew safety courtesy behavior. Thus, this study hypothesizes that:

Hypothesis 1:Fleet safety climate has a positive direct effect on safety courtesy.

The Mediating Role of Safety Knowledge

Safety knowledge can be viewed as an ability to know and recognize issues about the importance of safety at work (6). In the event of an emergency or an unforeseen incident, such as an in-flight technical malfunction, bad weather circumstances, or terrorist threats, safety awareness is critical. Flight crew with safety knowledge can recollect what they have studied and behave in response to the demands of adversity. The manner in which flight crews respond to adversity and choose the best course of action is critical to safer flight operations (21). Safety decision-making especially during unfavorable situations can be recalled automatically when flight crews gain safety knowledge (22). This also corresponds to the system one thinking process, which is an unconscious mechanism that permits knowledge to be swiftly retrieved when a challenging circumstance arises. (23). Furthermore, it has been proposed that informal learning occurs regularly at the fleet level through peer socialization when flight crews discuss work-related information with colleagues in the same fleets. Empirical evidence suggests that safety knowledge plays an essential mediating role in the relationship between safety climate and safety behaviors in a variety of circumstances. This study attempts to replicate those findings in the context of aviation. Based on the preceding discussion, it is hypothesized that:

Hypothesis 2: Safety knowledge play mediating role in the relationship between fleet safety climate and safety courtesy.

The Mediating Role of Safety Motivation

Individuals' safety work behavior is heavily influenced by safety motivation, according to the previously discussed social learning theory, and they can be motivated to adjust their behavior to conform to workplace cultural norms if it is perceived that safety-related compliance will eventually lead to a desirable safety outcome (24). Safety motivation is successful when there is a high level of safety emphasis within the interaction process of the work environment, supporting their safety performance. Safety motivation is crucial in aviation for flight crews to correctly assess and determine how to respond to unforeseen scenarios in which safety may be jeopardized. The way the flight crew reacts in particular situations and chooses the best course of action is critical to safer operations. (21). Past studies had also portrayed that safety motivation plays an mediating role in the relationship between safety climate and safety behaviors in various contexts (15,25)Based upon these arguments, this study tries to affirm the mediating role of safety motivation in an aviation context. In particular, it is anticipated that safety motivation will mediate the influence of fleet safety climates on safety courtesy. Thus, it is hypothesized that:

Hypothesis 3: Safety motivation play mediating role in the relationship between fleet safety climate and safety courtesy.

According to reviews of related literature above, conceptual model can be developed as shown in Figure 1.

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3.Methodology

This study is a cross-sectional behavioral science survey investigation employing a quantitative methodology. Thai flight crews make up the majority of the population. A total of seven air carriers were chosen as samples from both airplane and helicopter firms. After being granted access by each airline company's HR division, self-administered surveys were distributed to the target samples via the organization's intranet. Instrument was divided into 5 sections including fleet safety climate, safety knowledge, safety motivation, safety courtesy and demographic data. One advantage of using email-based surveys is that the respondents' anonymity may be validated. Seven hundred surveys were distributed. In total, 590 replies were received in their whole. This precise sample size was determined a priori by considering the appropriate sample size for assessing structural equation modeling, which is at least 200 or around 8-15 cases per manifest indicator, whichever is greater (26).

The original scales were developed in English and they were all translated into the Thai. A complete list of items and their measurement properties are presented in Table 2. *Fleet Safety Climate* (α = 0.95) was measured using the 3-item scale adapted from the study by Neal and Griffin (2006). *Safety Knowledge* (α = 0.92) was measured using the 3-item scale developed by Guo (2016). *Safety Motivation* (α = 0.92) was measured using the 3-item scale developed by Neal and Griffin (2006). *Safety Courtesy* (α = 0.89) was measured using the 6-item scale developed by Lu (2017). All scales were based upon a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*).

Analysis process was totally calculated by R, a loyalty-free statistical computational language. Several indices were determined to evaluate the model fit (27). Following the examination of concept validity, the hypothesized structural model and path analysis would be examined. The primary goal of this path analysis was to test hypotheses on the direct, indirect, and cumulative effects of fleet safety climate on safety courtesy.

4.Results and Discussion

Descriptive Statistics

For the descriptive of the dataset. Most respondents were male (93.60%), holding a bachelor’s degree or equivalent (75.6%). The majority of the flight crews received sponsorship for flight training (57.7%), flew as Piot-in-Command (51.3%), obtained Air Transport Pilot License (53.3%) and operated airplane (76.6%). All six demographic variables were controlled in the analyses. The result revealed that none of these demographic variables had significant effects on safety courtesy. Thereby, these were not included in the further analysis.

Common Method Variance

Owing to the nature of self-administrative questionnaire used in this study, common method variance might be expected and the test was performed to examine the possibility of the issue (28). CFA single factor method was utilized to test CMV. This method described that all manifest variables in the study were combined into one big latent variable and tested for fit indices. If this one latent model did not fit with empirical data, there would be no CMV issue. The results showed that this one latent variable model had a poor fit to the empirical data (χ^2 = 2,548.91, df = 90, p< .000; GFI = 0.57; CFI = 0.63; TLI = 0.57; RMSEA = 0.21; SRMR = 0.11). Therefore, there is no CMV problem.

Construct Validity of Measurement Model

Measurement model in this study was fitted with empirical data according to model fit indices (χ^2 = 345.77, df = 84, p< .000; Relative χ^2 = 4.11; GFI = .92; CFI = .96; TLI = .95; RMSEA = .07; SRMR = .03). The discriminant validity of the constructs was analyzed by using the square roots of the Average Variance Extracted (29). As shown in Table 1, the size of the square roots of AVEs values was greater than standardize multiple correlations. This indicated the sufficient discriminant validity among constructs. In terms of convergent validity, the factor loadings on each construct were analyzed. As shown in Table 2, the standardized factor loadings were all above .60, ranging from .70 to .91. The size of the Average Variance Extracted for each variable was also acceptable at the recommended value of .50. Composite Reliabilities (CR) of constructs also ranged from .88 to .91, exceeding the recommended value of .70 (30). Besides, Cronbach’s alphas showed sufficient levels of reliability of internal consistency, ranging from .88 to .91 (31).

--- Insert Table 1 Right Here ---

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According to sufficient reliability and validity of measurement model, the hypothesized structural model was then put into an analysis All paths were estimated as shown in Table 3. Mediated structural regression model was fitted with empirical data as per model fit indices ($\chi 2$ = 382.67, df = 85, p< .000; relative $\chi 2$ = 4.50; GFI = .92; CFI = .95; TLI = .94; RMSEA = .07; SRMR = .05).

--- Insert Table 3 Right Here ---

According to Table 4, the results of the path analysis revealed that the fleet safety climate had a favorable and considerable direct effect on safety courtesy. The total effect of the paths was significant. There were also two avenues of indirect impacts that were significant. This meant that safety knowledge and safety motivation both had a role in mediating the relationship between fleet safety climate and safety courtesy. As a result, all hypotheses were completely supported.

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5.Conclusion and Recommendation

This study adds to the body of knowledge in the behavioral science and safety literature by focusing on the impact of fleet safety climate on flight crew safety courtesy behavior through safety knowledge and safety motivation. This study shows that the fleet safety climate can also influence positive safety behaviors among flight crews, potentially leading to safer flight operations. According to the findings, fleet safety climate might be considered another important part of team working relationship that helps flight crews feel like they are on the same team and must work together to ensure a better operation, as indicated in previous research (32). Moreover, professionalism among flight crew is considered as the most valuable asset in the airline (33). As a result, airlines should stress these variables and promote fleet-wide safety policies in order to foster positive safety behaviors among flight crews, resulting in safer flight operations.

Despite the findings, some limitations are possible. First, while this study focuses on individual perceptions of safety, future studies may expand on the findings of this study by employing a multilevel analysis, as views of psychological-related factors can be more efficiently evaluated at both the individual and group levels (34). Second, quantitative analysis is used to obtain the results. There may be some undiscovered consequences that quantitative analysis cannot uncover. Future studies may alter the qualitative research approach to enrich the analytical results in more ways.

7.Declaration of Ethics Approval

Because this study is a non-interventionalstudy, where ethical approval is not required by national laws, there is no ethical approval in this study.

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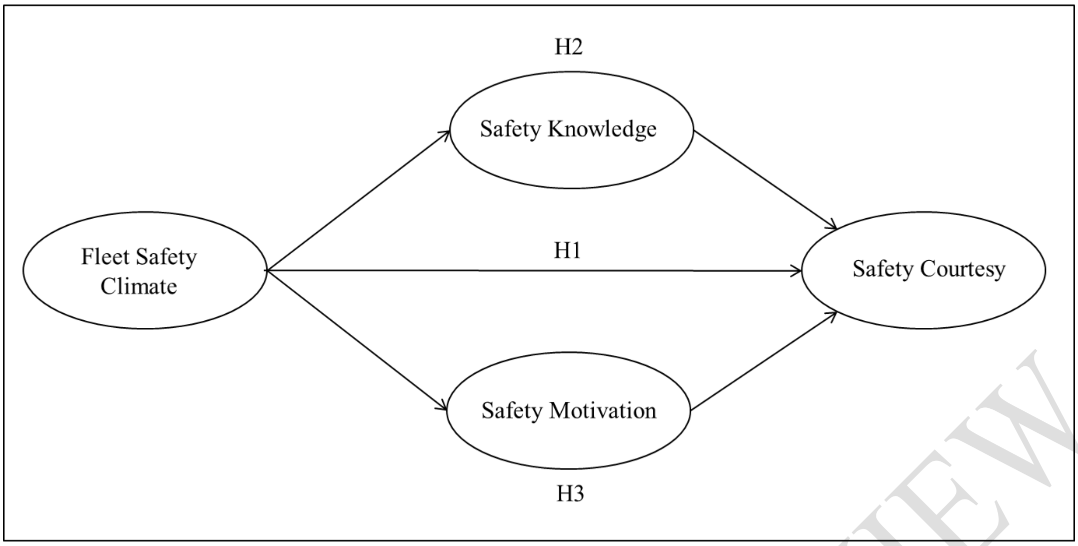

Figure 1. Conceptual Model

Table 1. Mean, Standard Deviations, Bivariate Correlations, Standardized Multiple Correlation and Square Roots of Average Variance Extracted

Variable (N = 610)	Mean	*SD*	1	2	3	4
1. Fleet safety climate (FSC)	4.49	.66	***(.87)***	.56	.66	.52
2. Safety knowledge (KNW)	4.35	.58	.60	***(.83)***	.55	.58
3. Safety motivation (MTV)	4.67	.52	.71	.60	***(.85)***	.57
4. Safety courtesy (SCO)	4.39	.56	.56	.63	.61	***(.79)***

Note. All bivariate correlations are significant at $p < .00$; Numbers below diagonal line are bivariate correlations; Number over diagonal line are standardized multiple correlations shared between constructs; Numbers in the diagonal line in parentheses are square roots of AVEs, which are greater than the size of standardized multiple correlations shared between constructs ensuring adequate discriminant validity.

Table 2. Standardized Factor Loadings, AVE, CR and Cronbach's Alpha

Variables	Items	Loadings
Fleet Safety Climate (FSC)	*AVE = .77; CR = .91; α = .91*	
	1. My fleet places a strong emphasis on workplace health and safety. (FSC1)	.88
	2. Safety is given a high priority in my fleet. (FSC2)	.84
	3. My fleet considers safety to be important. (FSC3)	.91
Safety Knowledge (KNW)	*AVE = .72; CR = .88; α = .88*	
	1. I know how to maintain or improve workplace health and safety. (KNW1)	.84
	2. I know how to reduce the risk of accidents and incidents in the workplace. (KNW2)	.90
	3. I know what are the hazards associated with my jobs and the necessary precautions to be taken while doing my job. (KNW3)	.80
Safety Motivation (MTV)	*AVE = .72; CR = .88; α = .88*	
	1. I feel that it is worthwhile to put effort to keep and improve personal safety. (MTV1)	.79
	2. I feel that it is important to maintain safety at all times. (MTV2)	.88
	3. I believe that it is important to reduce a risk of accidents or incidents in workplace. (MTV3)	.98
Safety	*AVE = .63; CR = .91; α = .91*	

Courtesy (SCO)	1. Passing along information to co-workers. (SCO1)	.70
	2. Trying to prevent co-workers from being injured on the job. (SCO2)	.81
	3. Informing co-workers to obey safety rule. (SCO3)	.81
	4. Inspecting new co-workers to follow safety procedures. (SCO4)	.83
	5. Taking action to stop safety violations to protect co-workers. (SCO5)	.82
	6. Being aware of the safety of co-workers. (SCO6)	.79

Note. AVE = average variance extracted; CR = composite reliability; *α* = Cronbach's alpha; All standardized factor loadings are significant at $p < .00$

Table 3. Mediated Structural Regression Model-Estimated, Standardized Coefficient and R^2

Structural Regression	*EST*	*STD*	*p*	R^2
Safety Courtesy (SCO) was regressed on				.42
Fleet safety climate (FSC)	.09	.12	.03*	
Safety knowledge (KNW)	.32	.36	.00***	
Safety motivation (MTV)	.30	.29		
Safety Knowledge (KNW) was regressed on				.33
Fleet safety climate (FSC)	.49	.57	.00***	
Safety Motivation (MTV) was regressed on				.44
Fleet safety climate (FSC)	.51	.67	.00***	

Note. EST = Estimated Coefficients, STD = Standardized Coefficients, *$p < .05$, ***$p < .00$

Table 4. Direct Effect, Indirect Effect and Total Effect – Mediated Path Analysis

Direct Effect, Indirect Effect and Total Effect	*EST*	*STD*	*SE*	Z	*p*
Direct Effect: (FSC > SCO)	.09	.12	.04	2.14	.03*
Indirect Effect 1: (FSC > KNW > SCO)	.16	.20	.02	6.71	.00***
Indirect Effect 2: (FSC > MTV > SCO)	.15	.20	.02	5.39	.00***
Contrasting Effect: Ind. Eff.1 vs Ind. Eff. 2	.01	.01	.03	0.14	.88
Total Effect	.41	.53	.03	11.69	.00***

Note. SE = Standard Error, *p < .05, ***p < .00