

Development of Utilities to Assess Airline Cabin Safety Culture

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Abstract

In order to identify factors that contribute to a cabin safety culture, a comprehensive survey questionnaire was created based mainly on a survey form used in offshore environments (Cox and Cheyne, 2000). The survey was randomly distributed to 391 cabin crewmembers among four major Taiwan national airlines, and achieved a valid response rate of 84.65 per cent. A Likert five-point scale questionnaire was integrated in the survey. SPSS software was utilized, and various tests including descriptive statistical analysis, factor analysis, reliability analysis, mean analysis, and one-way Analysis of Variance (ANOVA) were employed for data analysis. Nine factors were extracted using *Factor Analysis* to represent the safety culture and safety performance. Data revealed that cabin crew background is an influential element, where different backgrounds resulted in a different perception on safety culture factors. Findings also suggested *management/supervisor commitment and leadership, cabin work environment, safety knowledge and training, safety rules and procedures compliance, crewmember involvement in cabin safety issues, and cabin accident/incident/near misses investigation* were regarded as the priority areas for focusing improvement effort, where they all had descriptive mean values lower than the midpoint of 3.0. The outcome of these development and assessment endeavors has provided the airline management with a new perspective for an improved cabin safety culture.

Keywords: Cabin crew, Cabin-related hazard, Cabin safety, Safety culture, Cabin safety culture, Safety performance

Introduction

Cabin safety is an important consideration in civil aviation, yet some findings of the U.S.A. Federal Aviation Administration (FAA) showed that cabin crewmembers are at the greatest risk of injury because they often continue working after the seat-belt sign is illuminated (FSF Editorial Staff, 2001). Flight Safety Foundation-Taiwan (FSF-Taiwan) has compiled and analyzed statistics of Taiwan national airline cabin abnormal events provided by six major national airlines. The FSF-Taiwan study pointed out that the cabin crew injury rate continues to increase at a rapid rate (FSF-Taiwan, 2005). Moreover, according to the latest International Air Transport Association (IATA) report, the cabin crew injury and illness rates were significantly higher than those of other commercial air transport workers (IATA, 2006). By combing these reports, we get a more accurate and complete picture of where the risk lies for the air carrier workers.

A cabin crew consists of professional people who are in charge of the cabin and responsible for ensuring compliance with all related safety regulations. All airlines whether a low-cost or a major airline must have crew on board for safety and security reasons. A question was raised as to what caused a higher occurrence of occupational injury, illness or incidents with airline cabin crew. According to Guldenmund (2000), safety culture is the leading indicator of safety performance. Numerous studies have been performed to define and assess safety culture in a wide variety of safety-critical industries such as the nuclear, oil, gas, chemical, offshore, construction, etc., yet little research has been conducted to investigate the relationship between safety culture and safety performance (von Thaden, Wiegmann, Mitchell, Sharma, and Zhang, 2003). Recently, many industries around the world have shown an increasing interest in the concept of safety culture as a means of

reducing the potential for large-scale disasters, and accidents associated with routine tasks (Cooper, 2000). Therefore, the purpose of this research was to develop utilities to assess airline cabin safety culture within any airline crew and then to generate specific recommendations for airline management regarding how to achieve cabin safety.

Literature Review

Cabin Crew

A cabin crew is in charge of the passenger cabin area and should ensure compliance with all applicable regulations (for example, the Civil Aeronautic Administration-Taiwan Aircraft Flight Operation Regulations, Canadian Aviation Regulations, Federal Aviation Regulations, Joint Aviation Requirements, etc.). It is the responsibility of crew members to follow and enforce company policies and procedures and regulatory requirements (Transport Canada, 1996). It is common for a Flight Attendant Manual Standard to specify that a flight attendant's responsibility is to communicate any onboard safety concern they may have or that may be communicated to them by a passenger to the captain (Transport Canada, 1996). Therefore, cabin crew must be familiar and comply with company safety policies, procedures, and regulations and respond as trained to turbulence, decompression, cabin fire, security related issues, and evacuation if forced to land or ditch in the water.

Cabin-related Hazard

Livingston (1992) demonstrated that during normal duties, cabin crewmembers are exposed to numerous situations where injuries can occur. Although the injuries in his study were minor, the potential for serious injury was present. According to *Cabin Crew Safety* (Livingston, 1992) and other related cabin safety reports, cabin-related hazards can be categorized as turbulence, decompression, fire, medical emergencies, inappropriate cabin or galley layout, short haul flight time stress, long working hours, jet lag, and standing for long periods. Lifting and stowing of baggage, lifting bar containers, pushing and pulling bar carts or trolleys as well as opening overhead bins may lead to occupational injuries. Unruly or sick passengers present a risk of potential threats. Among nonfatal air carrier accidents, turbulence has been the leading cause of in-flight injuries to passengers and flight attendants in the United States (FSF Editorial, 2001). This result is the same as results reported by FSF-Taiwan, which also found that turbulence is the major casual factor of injury (FSF-Taiwan, 2005). In several instances, handling hot liquids such as instant noodle soup, rice porridge, and hot coffee may contribute to the injuries especially in Taiwan national airlines (FSF-Taiwan, 2005). Consider the following events which have happened to cabin crew in Taiwan national airlines during the past years.

1. Turbulence

Among nonfatal air carrier accidents, turbulence has been the leading cause of in-flight injuries to passengers and flight attendants in the U.S.A. (FSF Editorial, 2001). Cruise is the predominant phase associated with turbulence-related injuries, accounting for 52 per cent of all events and 44 per cent of these events happen in the galley (IATA, 2005). For example, four cabin crewmembers were injured when they encountered sudden and severe Clear Air Turbulence in a flight from Taipei to Abu Dhabi. They were lifted off the floor while standing unrestrained in the galley during unexpected turbulence. IATA (2005) pointed out that the majority of turbulence-related injuries were minor, yet almost 10 per

cent of injuries suffered by cabin crew were serious. In this case, a senior male flight attendant was maimed and has spent the rest of his life in a wheelchair due to turbulence and the delay of medical treatment.

2. Unruly Passengers

Ground staff had already detected a woman speaking loudly and boisterously when she was at the checking-in counter, but they did not notify any related personnel immediately. Perhaps due to the emphasis on passenger service or a lack of awareness of safety, they did not prevent this passenger boarding and did not take any positive preventative action. Although the purser had been informed and one or two flight attendants had identified the threat while the passenger was boarding, they still assumed that everything would be fine. The passenger then continuously hit another passenger sitting beside her in flight and was spoken to by the airport police authority after landing.

3. Slide Deployed

Inadvertent slide deployment can cause serious or fatal injury to people in or around an aircraft. IATA (2005) data revealed that 59 per cent of accidental slide deployment was caused by cabin crew inadvertent errors and 53 per cent of these incidents happened at arrival phase. In a charter flight from Taipei to Hong Kong in the early morning, a junior flight attendant deployed an Airbus 340 3R slide due to lack of sleep. In fact, the 3R exit door does not normally need to open. Replacing the deployed slide in Hong Kong resulted in a delay to the returning flight. On another flight from Ho Chi Min City to Taipei, Boeing 737-800 3L an attendant deployed a slide while answering a passenger's serving call button during taxiing. That slide dropped down on the catering's cart and was not deployed. Fortunately, nobody was hurt.

4. Cabin Crew Competence

As three senior flight attendants in first class were preparing to serve breakfast on a flight from Los Angeles to Taipei, one of them opened the oven using normal procedure that they were taught at training class. All of a sudden, the oven, being overheated for one hour and 30 minutes, exploded. The beef noodle soup spilled on the other attendant who was standing beside the oven and preparing table settings. After investigation, it was found that the training instructors had given crew the wrong procedure for using these kinds of steam ovens.

5. Rule Breaking

Although the seat belt sign was illuminated and descent had commenced, a crewmember still allowed a passenger to use the lavatory while the aircraft was below 10,000 ft. The passenger could not get out, and had to stay in the lavatory until the airplane touched down. The crewmember neglected the required checks of the lavatories and didn't inform the cockpit crew immediately that the cabin was not ready for landing. Compliance with safety regulations is very important because crewmembers are critically important in reducing cabin-related hazards. In 1931, Heinrich's safety pyramid or accident pyramid theory showed that for every 300 unsafe acts there are 29 minor injuries and one major injury (Heinrich, 1959). Thus, if all crewmembers strictly adhere to safety standard operating procedures then major injury would not occur.

6. Conflict between Passenger Service and Cabin Safety – Management Commitment

5L could not get back to her seat prior to landing because she sold duty-free items to a full load of 747 passengers until the gear went down. In fact, this case breached the

CAA-Taiwan Civil Aviation Law. The crewmember was not aware of the situation when she focused on her duties selling duty-free items. Some airlines place a high emphasis on the sale of duty-free items for commercial reasons, which can place cabin crewmembers under pressure to complete the service in the time available. Especially in regional short haul flights that provide elaborate passenger service, everyone, whether senior management, purser, or cabin crew, need to carefully consider cabin-related hazards that could cause potential injury.

7. Work Environment

The civil regulations specify the number of pieces, sizes, and weights of passenger's carry-on baggage which may be placed in the overhead bins or under the seat in front. Loose objects in the cabin may cause injuries, yet a safe work environment could prevent cabin incidents and personal injury. Safety cases obtained from reviewing papers on cabin safety and face-to-face airline crewmember interviews show that an opened, oversized refrigerator door as well as any protruding objects can cause injuries when a crewmember suddenly stands up after retrieving an item from the bottom of a cart.

Cabin Safety

The goal of cabin safety is to increase the survival rate by minimizing hazards in the cabin and its environment to reduce the effects of an accident (Transport Canada, 2005).

The Cabin Safety Standards Division at Transport Canada uses the following working definition to best describe cabin safety (Transport Canada, 2005):

Cabin Safety is a field that reduces fatalities and injuries resulting from an accident and provides for a safe environment for passengers and crew members in and around the aircraft, prior to and during boarding and deplaning phases, while the aircraft is on the airport apron with people on board, and during the operation of the aircraft. It includes the aircraft cabin, its exits, its configuration, its furnishings, its equipment and its people.

IATA (2005) *Cabin Operations Safety Programme* pointed out that a cabin crew's duty is not limited to in-flight service and post-accident evacuation. The aim of Cabin Safety is to reduce the number of incidents, accidents and significant costs to airlines in injuries and material damage.

Safety Culture

Recently, management has come to realize that the general likelihood of an accident occurring in their organization depends not just on the actions of individual employees but on the safety culture of the organization. Organizational culture gained much attention in the 1970s and 1980s and it can be defined as 'the way we do things around here'. Safety culture can be described as the way in which the organization conducts its business and particularly in the way it manages risks (IATA, 2005). Many studies have attempted to define safety culture and its dimensions but one that is most widely used and explicit is that developed by the Advisory Committee on the Safety of Nuclear Installations (ACSNI) (HSE, 1993).

The safety culture of an organisation is the product of individual and group values, attitudes, perceptions, competencies and patterns of behaviour that determine the

commitment to, and the style and proficiency of, an organisation's health and safety management.

Cox and Cox (1991) presented a safety model which distinguishes four objects – hardware, software (i.e. rules and procedures, safety management and policy), people/liveware (i.e. workers, supervisors, management, safety committees, specialists, authorities, unions) and risks (safeness of work environment, risky behavior and its regulation). Geller (1994) proposed a model which demonstrated three interactive dimensions between person, behavior, and environment in safety. Another very similar and useful framework demonstrated by Cooper (2000) also distinguished three interrelated aspects of safety culture. It contains three elements which encompass internal psychological factors, behavioral aspects and situational features. The internal psychological aspects which reflected how people feel about safety can be assessed via safety climate questionnaires concerned with individual and group values, attitudes, and perceptions. Actual ongoing safety-related behavior aspects which are concerned with what people do can be assessed through checklists developed as a part of behavioral safety initiatives, while the situational features describes how the organizations are assessed via policies, procedures, work environment, and safety management system audits/inspections (Cooper, 2000).

Cox and Cheyne (2000) demonstrated that, “culture in general, and safety culture in particular is often characterized as the enduring aspect of an organization clearly and is not easily changed. Although over the years a variety of questionnaires have been developed by different researchers in an attempt to identify the key factors that comprise safety culture there has been little agreement concerning which dimensions should be incorporated into safety culture”. They identified nine factors covering the most popular areas of management commitment, communication, priority of safety, safety rules and procedures, involvement, work environment.

Management commitment is regarded as a prime factor of safety culture (Guldenmund, 2000). Cox and Cheyne (2000) argue that management commitment, management actions concerning safety and the physical work environment were the common components of safety culture. The findings of Flin, Mearns, O'Connor, and Bryden's research (2000) revealed that the most typically assessed safety dimensions related to management (72 per cent of studies), the safety system (67 per cent), and risk (67 per cent). They also found that the supervisor or foreman is the key person in industrial accident prevention. As well, several studies have pointed out that the first-line supervisor plays an important role in shaping the safety culture within an organization, setting the work atmosphere, and motivating employees to perform their tasks safely (Zohar, 2000; Flin et al., 2000; Neal & Griffin, 2002; Lee, 2006).

Effective communication can be categorized as top-down communication in which safety issues are passed on from management to frontline staff via safety policy statements, newsletters, or the intranet, confidential safety reports in which people are prepared to report accidents, incidents, near misses, and safety concerns, and horizontal communication between peers. Similar to NASA's Aviation Safety Reporting System (ASRS), FAA's Aviation Safety Action Programs (ASAP), and the Confidential Human Factors Incident Reporting Program (CHIRP), the Taiwan Confidential Aviation Safety Reporting System (TACARE) is operated by the Aviation Safety Council (ASC), Executive Yuan, Taiwan, 2002. TACARE encourages all airline related personnel in the aviation community including flight crew, maintenance, air traffic controllers, flight attendants, or any other

person to report to this structured reporting system which provides an independent reporting channel based on the concept of being “confidential, voluntary and non-punitive”. They have also reported many cases regarding Taiwan national airline cabin safety issues during past years.

Safety systems have been defined as including factors relating to safety officials, safety committees, safety policies, and safety equipment. Work environment is also an important factor. Cabin crew working in the cabin is the same as any employee working in an office work environment. Work environment factors can be assessed via surveys. The term workplace is also used. Guldenmund (2000) proposed that safety cultures have been characterized as multi-dimensional by various statistical analysis techniques in social scientific research. He considered these factors are the result of inter- and intra-respondent tendencies to evaluate certain questions in a similar way. Thus, there is no overall satisfying model of safety culture. For instance, HSE (2005) concluded that five factors of positive safety culture are leadership, two-way communication, employee involvement, learning culture, and attitude towards blame. In summary, although a lot of different factors have been found to underlie safety culture, the most commonly measured factors are regarded as management commitment, communication, priority of safety, and work environment followed by competence.

Safety Performance

Perceptions of safety rules, attitudes to rules and compliance or violation of procedures are related to risk-taking behaviors. These can involve rule breaking which may result in an accident (Flin et al., 2000). Although there is a lack of research which supports the view that top management’s commitment to safety is a feature of low-accident companies, Marsh, Davies, Phillips, Duff, Robertson, Weyman, and Cooper (1998) have illustrated that management commitment to safety affected actual performance. Glendon and Litherland (2000) pointed out that traditional measures of safety performance rely primarily on accident or injury data but the main problems are that such data are insufficiently sensitive and dubious in accuracy. They argued that one method developed to overcome some of the limitations associated with traditional measures of safety is “behavior sampling”. Furthermore, the measurement of safety culture/climate could be considered an alternative safety performance indicator, whereas the assessment of safety culture provides more insight into both safety improvements and unforeseen major accidents as noted by Pidgeon (Pidgeon 1998, cited in Guldenmund, 2000).

There are a variety of quantitative and qualitative measurement tools available that can be used to assess safety culture. Questionnaires, peer observations, self-reports, historical information reviews, case studies, safety audits of safety management systems, etc. can examine the psychological, behavioral, and situational aspects of safety culture (Cooper, 2000). Surveys, which comprise a series of questions that measure people’s beliefs, values, attitudes and perceptions along various dimensions of safety thought, are the most common method. Guldenmund (2000) suggests that research should not be undertaken to develop new measurement tools, but should rather focus on the validity of the construct and whether it indeed yields a vigorous indication of an organization’s safety performance. This study compiles and validates a survey that assesses and identifies cabin safety culture factors within airline cabin crewmembers. The emphasis is on these commonly used measurement tools that have been developed and widely accepted in many industries as applied to the aviation community.

Methodology

Current research shows that safety culture can be assessed through the use of safety culture questionnaires. Therefore, a list of questions relevant to cabin safety in commercial airlines mainly based on the “Safety Climate Assessment Toolkit” used in offshore environments (Cox and Cheyne, 2000), “Airline Safety Culture Index” (Edkins, 1998), and the “Safety Assessment Questionnaire” used in the aviation industry (Gill and Shergill, 2004), in addition to items gathered from an extensive literature search and consultation with specialists for this study was compiled to ask Taiwan four major national airlines cabin crewmembers about their perceptions of cabin safety (Lee, 2006). Demographic questions concerning the respondents’ nationality, gender, work length, qualifications for serving class, injury experience, and the airline company employing them were also asked. This survey was pre-tested on a small number of cabin crewmembers among one of the four major airlines in Taiwan and revised before a final version was used to ask cabin crewmembers about their opinions, feelings, and perceptions towards cabin safety. The final version of the cabin safety culture survey comprised 35 questions. Responses were recorded on a five-point scale from (5) strongly agree to (1) strongly disagree. SPSS software was utilized in this study, and various tests including descriptive statistical analysis, factor analysis, reliability analysis, mean analysis, and one-way Analysis of Variance (ANOVA) were performed for data analyses.

Based on an extensive literature review, it was hypothesized that a positive safety culture perceived by airline cabin crewmembers (i.e. a high score of management/supervisor commitment and leadership, safeness of cabin work environment, communication, crewmembers’ safety awareness, safety knowledge and training, etc.) would result in better safety performance (i.e. a high score of cabin accident/incident/near miss investigation, crewmember involvement in cabin safety issues, safety rules and procedures compliance).

The survey was distributed to 391 randomly selected cabin crewmembers on four national airlines currently registered by the Civil Aeronautics Administration, Taiwan. A plain language letter accompanied the survey, highlighting the aims of the study and encouraged crewmembers to express their true feelings. In total, 331 responses were received and valid, representing a high valid response rate of 84.65 per cent. Of these responses 281(84.89 per cent) had been employed in Airline Company A, 32 (9.67 per cent) had been employed in Airline Company B, 13 (3.93 per cent) had been employed in Airline Company C, and 5 (1.51 per cent) had been employed in Airline Company D. The data show that the returns from each airline company very closely match the proportion of cabin crewmembers registered with these four major Taiwan national airlines.

The sample was predominantly native cabin crew (95.5 per cent), and 86.4 per cent were female. Seventy-one point six per cent of the participants had worked for six years or more, and only 3.6 per cent were pursers. Based on data provided by CAA-Taiwan, there was no evidence that this sample was unrepresentative of the total population. In addition, about 59.8 per cent of the respondents indicated that they had been involved in an accident, incident, near miss, or minor injuries as a result of their work as a flight attendant with the airline.

Results and Discussion

Factor Analysis and Reliability

Factor analysis was used to define the underlying structure of the data set. A series of questions about several aspects that were thought to be related to the topic of interest was asked. The variables based on the strongest relationships or highest inter-correlations were grouped together and then named. The 35 items were subjected to a factor analysis with principal component extraction and varimax rotation. The initial factor solution was identified by the decision rule that eigenvalues should be greater than or equal to one. Furthermore, in any summation of factor scores, these loadings may be used to weigh individual items. Each factor can be thought of as a measurement scale for that particular feature. The analysis was conducted on responses to these items to determine that factor structure. With all 35 items in this survey, the obtained Cronbach's Alpha was 0.875, indicating that it was good and appropriate to apply the factor analytic technique to these data sets.

In safety culture dimension, 23 items assessed perceptions of safety within airlines' cabincrew. A subsequent analysis yielded a six-factor solution, accounting for 58.067 per cent of the explained variance. The factors were named *management/supervisor commitment and leadership*, *cabin work environment*, *personal priorities and need for safety*, *crewmember safety awareness*, *communication*, and *safety knowledge and training*. The reliability coefficient of the safety culture dimension was 0.836. Twelve items assessed safety performance, including factors of *safety rules and procedures compliance*, *crewmembers' involvement in cabin safety issues*, and *cabin accident/incident/near miss investigation*. Reliability coefficients for these factors ranged from 0.701 to 0.869. These three factors accounted for 53.332 per cent of the total variance. Table 1 displays the factors, example items, and each variable's factor loading, their percentage of explained variance and reliability alpha.

The first factor loaded heavily on the first ten variables. This strongest and prime factor was interpreted as management/supervisor commitment and leadership, reflecting the airlines' safety culture related to perceptions of management/first-line supervisor attitudes and behaviors in relation to cabin safety as well as to passenger service, or other issues (production, profit, etc.). This factor alone has explained nearly half of the total variation in this factor solution. It generally is measured by respondents' satisfaction with senior managers or their perceptions of supervisor/purser's attitudes and behaviors with respect to safety.

The interpretation of the second factor was termed cabin work environment because it contained items which included ergonomic design of cabin, galley layout, service equipment maintained to a safe standard, sufficient service time, and conflict between cabin service and safety. The third factor was interpreted as personal priorities and need for safety which focused on the need for safety in the cabin crewmember's mind and the personal meaning to cabin crew. The interpretation of the fourth factor was as crewmember safety awareness since it is a collection of items about the perceptions of crewmembers towards to cabin safety.

The fifth factor was interpreted as communication with a focus on the extent to which crewmembers see as an effective information exchange within their worksite. The sixth

factor indicated individual safety knowledge and provision of airline safety training whether Crew Resource Management program, annual recurrent training, safety and emergency procedure training, safety and security training, or occupational health and safety training.

The seventh factor extracted was interpreted as safety rules and procedures compliance as it comprises seven items on aspects which would reflect the instances when and the reasons why crewmembers worked unsafely or do not comply with safety regulations, rules, and procedures. Perceptions of cabin safety regulations, attitudes to safety rules and compliance or violation of safety procedures are covered by this theme, which is also related to risk-taking behaviors as these can involve rule breaking. The eighth factor reflected a positive attitude to effective reporting, participating in, and being involved in cabin safety issues which may increase crewmember confidence in safety problems or cabin-related hazard and improve crewmember commitment to improving cabin safety. The last factor was labeled as cabin accident/incident/near miss investigation as the items reflected the quality of safety management system.

All factors contained at least two items and the internal consistency across items in each factor (alpha) was high for all factors except factor 4: crewmember safety awareness, and factor 5: communication. Since the deletion of any items in these two factors did not improve the alpha value much, these two factors were retained and their characteristics further explored.

Table 1

Results of the rotated factor analysis showing name of each factor, percentage of variance accounted for by each factor, the internal consistency between items for each factor (alpha) and the factor loadings for each item

	Loading
Safety Culture (58.067% Cumulative Variance, alpha=0.836)	
<i>Management/Supervisor Commitment and Leadership (22.921% Variance, alpha=0.887)</i>	
Management/supervisor clearly considers cabin safety of great importance.	0.803
I believe that cabin safety issues are not assigned a high priority.	0.763
Management acts decisively when cabin safety concern is raised.	0.727
Management operates an open door policy on cabin safety issues.	0.716
Management considers cabin safety to be equally as important as passenger service.	0.694
There is good communication here about cabin safety issues which affect me.	0.687
Management acts only after cabin accidents/incident/near misses have occurred..	0.670
In my workplace managers/pursers show interest in my safety.	0.670
In my workplace management acts quickly to correct safety problems.	0.639
In my workplace pursers turn a blind eye to cabin safety issues when they conflict with passenger service.	0.523
<i>Cabin Work Environment (9.595%Variance, alpha=0.680)</i>	
Sometimes I am not given enough time to get the job done safely.	0.812
Passenger service targets often conflict with cabin safety.	0.763
Sometimes cabin conditions/galley layout/ service equipment here hinder my ability to work safely.	0.664
I am sure it is only a matter of time before I am involved in an accident.	0.549
<i>Personal Priorities and Need for Safety (7.373% Variance, alpha=0.683)</i>	
Safety is the number one priority in my mind when completing a job.	0.864
A safe place to work has a lot of personal meaning to me.	0.834
<i>Crewmember Safety Awareness (6.348% Variance, alpha=0.426)</i>	
It is important that there is a continuing emphasis on cabin safety.	0.715
Corrective action is always taken when management is told about unsafe practices.	0.635
I understand cabin safety rules and procedures for my job.	0.590

Communication (5.975% Variance, alpha=0.472)

My supervisor/purser does not always inform me of current concerns and issues.	0.797
Safety information is always brought to my attention by my supervisor/purser.	0.753

Safety Knowledge and Training (5.854% Variance, alpha=0.591)

The recurrent training I had covered all health and safety risks associated with the work for which I am responsible.	0.761
Management places a low priority on cabin safety or crewmember personal safety training.	0.580

Safety Performance (53.332% Cumulative Variance, alpha=0.721)**Safety Rules and Procedures Compliance (21.436% Variance, alpha=0.708)**

Sometimes it is necessary to ignore cabin safety rules/procedures to keep passenger service going.	0.717
I take shortcuts which involve little or no risk.	0.707
Sometimes it is necessary to depart from safety requirements for passenger service' sake.	0.688
Crewmembers here are sometimes pressured to work unsafely by their colleagues.	0.665
Sometimes I am uncertain what to do to ensure safety in the work for which I am responsible.	0.490
Some cabin safety rules and procedures do not need to be followed to get the job done safely.	0.442
Sometimes cabin safety rules and procedures are not really practical.	0.429

Crewmembers' Involvement in Cabin Safety Issues (16.624% Variance, alpha=0.701)

I am involved in informing management of important cabin safety issues.	0.763
I feel involved when cabin safety procedures/rules are developed or reviewed.	0.761
I am strongly encouraged to report unsafe conditions.	0.726

Cabin Accident/Incident/Near Miss Investigation (15.272% Variance, alpha=0.869)

Members of investigation teams are trained to identify true root causes rather than blame human error.	0.835
The investigation system considers management and policy influences on the causes of cabin accident/incident/near miss.	0.810

ANOVA

In this study, the ANOVA combined the factors of management/supervisor commitment and leadership, cabin work environment, personal priorities and need for safety, crewmember safety awareness, communication, safety knowledge and training, safety rules and procedures compliance, crewmembers' involvement in cabin safety issues, and cabin accident/incident/near miss investigation to make a single variate. The groups of different demographic crewmembers were then tested for significant differences on this variate. The results of this analysis can be seen in Table 2.

There was no significant difference of the perceptions of some factors within different background crewmembers due to P value greater than 0.05. Differences were found in six of the questionnaire factors. For example, different crewmembers qualification such as junior crew who work in economy class, crew in business class, senior crew who serve in first class, and the purser resulted in different perceptions of management/supervisor commitment and leadership and cabin work environment. In these two factors, the supervisor/purser's perceptions were significantly different from all others. In addition, results showed that those who had not had injuries within the past years showed significantly different comments in management/supervisor commitment and leadership, cabin work environment, and safety rules and procedures compliance compared with those who had been involved in injuries. These findings are consistent with those of Lee (2006) suggesting that different cabin crewmember backgrounds resulted in different perceptions on most safety culture factors. The results also highlighted the areas in need of management attention and provided valuable insight for improvement of cabin safety.

Table 2
ANOVA Results

Factor	Nationality	Gender	Work Length	Qualification	Injury Experience
Management/supervisor Commitment and Leadership	n.s.	F=4.946*	n.s.	F=3.726*	F=8.130**
Cabin Work Environment	n.s.	n.s.	F=3.312*	F=6.147***	F=6.983**
Personal Priorities and Need for Safety	n.s.	n.s.	F=2.622*	n.s.	n.s.
Crewmember Safety Awareness	n.s.	n.s.	n.s.	n.s.	n.s.
Communication	n.s.	n.s.	n.s.	n.s.	n.s.
Safety Knowledge and Training	n.s.	n.s.	F=2.909*	n.s.	n.s.
Safety Rules and Procedures Compliance	n.s.	n.s.	n.s.	n.s.	F=5.660*
Crewmembers' Involvement in Cabin Safety Issues	n.s.	n.s.	n.s.	n.s.	n.s.
Cabin Accident/incident/near miss Investigation	F=7.981**	F=4.891*	n.s.	n.s.	n.s.

n.s.: no significant difference, *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$

Factors Scores

Performance scores for four major Taiwan national airlines on each of the nine factors of cabin safety culture were determined by calculating the mean of the participants' responses to the items in each scale. This study was particularly interested in different culture between four major Taiwan airlines. Therefore, an examination of differences between different respondents was also made. A series of ANOVA were performed and means for each factor scale appear in Table 3. Both Company A and Company B showed significantly lower evaluations than other companies in terms of management/supervisor commitment and leadership, and safety rules and procedures compliance. Company C, however, only differed significantly from others in terms of communication. Difference was found in the factor of cabin work environment with Company D showing significantly higher evaluations than the others. Company A showed significantly lower evaluation in the factor of safety knowledge and training than other companies.

Table 3
Means for the four major Taiwan national airlines involved in the study^a

Dependent Variable	Company A	Company B	Company C	Company D
Management/supervisor Commitment and Leadership	2.360	2.763	3.247	3.720
Cabin Work Environment	2.168	2.438	2.443	3.200
Personal Priorities and Need for Safety	4.490	4.315	4.655	4.400
Crewmember Safety Awareness	3.903	3.710	4.357	4.067
Communication	3.510	3.310	2.155	3.400
Safety Knowledge and Training	2.915	3.265	3.695	3.700
Safety Rules and Procedures Compliance	2.540	2.780	3.077	3.314
Crewmembers' Involvement in Cabin Safety Issues	2.667	2.687	3.100	3.333
Cabin Accident/Incident/Near Miss Investigation	2.240	2.470	2.735	2.500

^a Emboldened groups differ significantly from the others ($p < 0.05$)

Three hundred and thirty one cabin crewmembers took part in this study and the results of the cabin safety culture survey were represented on a radar plot graph (Figure 1). Each of the factors represented on the radar plot was scored on a standardized scale (out of five).

Responses on the factor of personal priorities and need for safety received an almost perfect score (mean = 4.479) from 331 Taiwan national airlines cabin crewmembers. Means of

factors to these data analysis show that respondents perceive “personal priority and need for safety” as the most important factor indicating “Safety is the number one priority in 90.60 per cent of cabin crewmembers’ mind when completing a job”. Almost all (96.10 per cent) crewmembers considered “A safe place to work has a lot of personal meaning to me” more important than other things.

The mean score (2.219) of the “work environment” of Taiwan national airline was extremely low which indicates that this factor is a key area where the airline management should be focused on for improvement. The mean score was only 1.85, the lowest value of 35 total items. For example, four out of five (83.40 per cent) crewmembers agreed and strongly agreed “Sometimes cabin conditions/galley layout/ service equipment here hinder my ability to work safely”. The fact suggests that when the company chooses cabin options offered by manufacturers, compatibility with cabin service should be given more consideration.

Several papers revealed that a well-designed galley will enhance the overall cabin service performance and at the same time ensure a safe cabin work environment (Lee, 2006). Hence, properly maintained equipment may prevent galley incidents and personal injuries. This study suggests that each service item such as meal, beverage cart or service trolley should be regularly maintained and upgraded, and adequate resources may be allocated to perform required maintenance. In addition, sliding drawers should slide in and out easily to avoid musculoskeletal injuries. Since cabin crewmembers often need time to get the job done safely, sufficient time should be given to crewmembers to complete their duty in a safe manner, no matter how rushed the regional short haul flight might be.

The second weakest factor selected was “accident investigation”, suggesting that members of investigation teams ought to be well trained to identify true root causes rather than blaming human errors. Proactive monitoring is where an organization monitors its performance before an accident, incident or near miss occurs, and includes measures such as audits, inspections and surveillance. Reactive monitoring is triggered after those cases. Only 19.6 per cent of respondent Taiwan airline cabin crewmembers agreed and strongly agreed that “The investigation system considers management and policy influences on the causes of incidents.” It is important to be aware of errors which can be managed by policy, line audits, safety reporting systems, training, etc.. These results provide further direction on how a safety management system ought to be operated when conducting a cabin accident/incident/near miss investigation.

Management/supervisor commitment and leadership to safety accurately perceived by cabin crew was one of the prime factors. The mean score (2.455) of this factor was below the midpoint of 3. The majority of cabin crewmembers held a negative opinion in regard to management commitment. The finding of this study also supports the general view that the purser plays a more important role in influencing the work environment than senior management. This research suggests that cabin safety issues should be a high priority especially when they conflict with passenger service. Airline management must operate an open door policy on cabin safety issues and should clearly consider cabin safety of great importance and equally as important as passenger service.

Overall, the results revealed Taiwan national airline’s strengths in the areas of cabin safety culture. The data implied that there is a substantial room for improvement. The outcomes also highlighted management/supervisor commitment and leadership (with a

standardized mean of 2.455), cabin work environment (with a standardized mean of 2.219), safety knowledge and training (with a standardized mean of 2.991), safety rules and procedures compliance (with a standardized mean of 2.596), crewmember’s involvement in cabin safety issues (with a standardized mean of 2.697), and cabin accident/incident/near miss investigation (with a standardized mean of 2.284) as the six areas most in need of improvement.

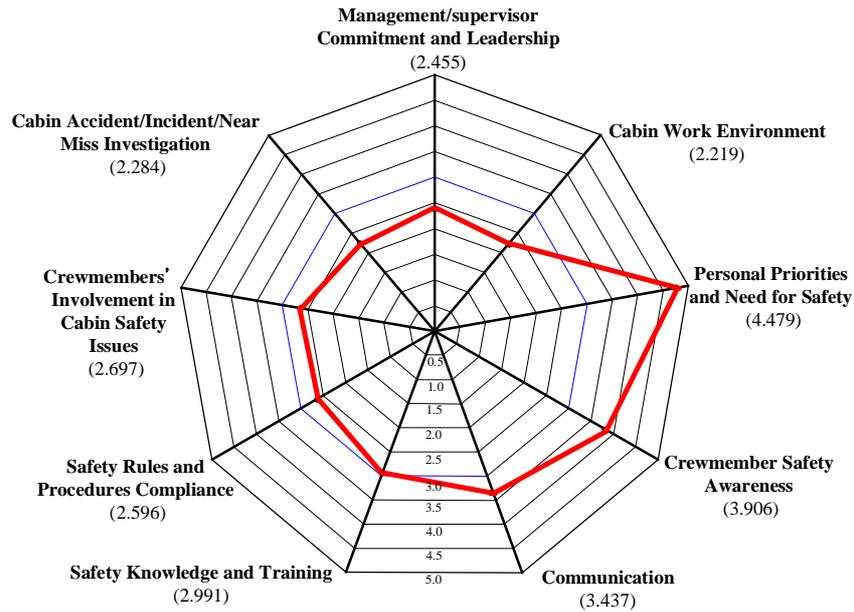


Figure 1 Radar Plot for Taiwan airline profiles in different cabin safety culture factors

It is important and imperative to balance cabin safety and passenger service. In summary, this study suggests that airline management should demonstrate care and concern toward crewmembers, provide a safety cabin work environment, and better identify true root causes rather than blame human errors when conducting cabin accident/incident/near miss investigation. The company must provide effective safety training to enable crewmembers how to perform work safely and have the skill to be able to do it in order to comply with cabin safety procedures. Poor training in the proper use of a service, safety, or emergency equipment is a safety issue simply because the chain of events set in motion by the poor training may be sufficient to cause cabin injuries, incidents, or accidents. Crewmember involvement in safety issues is also a necessary part of improvement of cabin safety. Moreover, minimizing cabin-related hazards, reducing injuries and saving lives is the utmost goal of improving cabin safety.

Conclusion

Cabin safety has become an important consideration in civil aviation. Results of this study supported that safety culture is both a major influence on people’s safety behavior and is related to safety performance as expected (Neal and Griffin, 2000; Lee, 2005). If an airline has the right culture in place, it will find the right people and the right technology to deliver safety and effective performance (HSC, 2003). Taiwan national airlines can play a critical role in cabin safety, as well as providing world-class passenger service.

Summary of Findings

Factors of management/supervisor commitment and leadership, cabin work environment, personal priorities and need for safety, crewmember safety awareness, communication, safety knowledge and training, safety rules and procedures compliance, crewmembers' involvement in cabin safety issues, and cabin accident/incident/near miss investigation were extracted by *Factor Analysis* to represent cabin safety culture and safety performance. Data revealed that cabin crew background is an influential element, where different backgrounds resulted in a different perception on management/supervisor commitment and leadership, cabin work environment, personal priorities and need for safety, safety knowledge and training, safety rules and procedures compliance, and cabin accident/incident/near miss investigations.

Overall, Taiwan airlines appear to exhibit “middle-of-the-road” cabin safety culture, with means scores near the neutral point (3.000) in most areas. Management/supervisor commitment and leadership, cabin work environment, safety knowledge and training, safety rule and procedures compliance, crewmember involvement in cabin safety issues, and cabin accident/incident/near misses investigation were regarded as the leading concern areas for focusing improvement of cabin safety, where they all had descriptive mean values lower than the midpoint of 3.0. The outcome of these development and assessment endeavors has also provided the regulator, operator, and airline management with a new perspective for an improved cabin safety.

Limitations and Future Directions

Numerous studies have been carried out to define and assess safety culture in various industries, yet little research has been conducted to measure airline cabin safety culture. It was difficult to develop the factors of cabin safety culture at the beginning of this research. However, the authors attempted to overcome this by conducting an extensive literature review, pre-survey interviews, consultations with experts, etc. A well-designed safety culture survey will be a cost effective and relatively straightforward way of gathering the data. This study suggests that more variables in relation to crewmember occupational health and safety or cabin abnormal events may be combined with the cabin safety factors to chart the full range of indicators in future research.

Conclusion

Notwithstanding the limitations of this study, the results provide valuable insights into cabin safety culture associated with improved cabin safety. This paper has proposed a useful methodology which developed and validated a survey that assessed and identified the key safety culture factors within any airline cabin crewmembers in general. While this research methodology has only been applied within the Taiwan airline environment, the process is sufficiently simple and flexible to be applied in other contexts. Ultimately, the outcomes confirm that this study has identified the underlying trends in perceptions of cabin crewmembers in the different factors of cabin safety culture and the findings has also highlighted the area most in need of airline management attention.

Acknowledgements

The authors acknowledge Dr. Kay Yong, former Chairman of Aviation Safety Council, Taiwan, Assistant Vice President Chien-Hsi Cheng, Captain Ming-Hui Lai, Captain Samson Yeh, Hsiao-Shian Sung, Samuel Lei, S.-Y. Niu, Teh-Yin Hsu in China Airlines, and Assistant Professor Hsing-Lin Wang, Ph.D. R.O.C. Air Force Academy who have given the authors much needed encouragement and consultation. Thanks go to all participant flight attendants of the four major Taiwan national airlines, who spent time to complete the survey and provided their precious perceptions. Finally, the authors would like to acknowledge Kai-Ping Lee, Ph.D., MBA, for his invaluable comments on an earlier draft of this paper.

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