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**Development and Initial Validation
of a Safety Culture Survey
for Commercial Aviation**

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Technical Report AHFD-03-3/FAA-03-1

February 2003

Prepared for

**Federal Aviation Administration
Atlantic City International Airport, NJ**

Contract DTFA 01-G-015

Abstract

The purpose of this study was to develop and initially validate a survey to assess safety culture within the commercial aviation industry. Based on a previous review of safety culture research, five global components of safety culture were identified including Organizational Commitment, Management Involvement, Employee Empowerment, Reward Systems, and Reporting Systems. Subsequent to this, an 86 item, 7-point Likert scale survey was developed to assess these cultural factors as they relate to pilots at a regional, FAR Part 135 scheduled air carrier. The goal was to allow employees throughout the airline (from line pilot to top-level management) to give their personal assessment of these organizational factors, taking into account the operational constraints of the airline and its personnel. Non-regulated organizational factors were targeted to help highlight possible areas of improvement in the airline. Feedback was also gathered from the airline on the techniques employed by the survey to measure safety cultural factors. The results from this survey indicated positive overall airline performance in relation to organizational safety factors. However, specific factors revealed areas in need of organizational attention for improvement. These target issues included areas of vulnerability perceived by the pilots. The results also allowed for refinement of the assessment instrument to improve its usability and validity. Future endeavors in this area will allow researchers to proactively pinpoint specific latent organizational factors in need of improvement that may be addressed to develop better patterns of organizational communication and overall safety.

Introduction

Numerous studies have been performed to define and assess safety culture in a variety of complex, high-risk industries, with few formally documented efforts made to assess safety culture within the aviation industry. A review of these studies reveals considerable variability among researchers regarding the fundamental nature of the safety culture concept. In fact, Pidgeon (1998) notes that empirical efforts to study the concept of safety culture have remained “unsystematic, fragmented, and in particular under specified in theoretical terms.” The goal of the present research program, therefore, is to remedy this situation by synthesizing previous research in this area and systematically developing a method for measuring safety culture within the aviation industry.

In a previous study, we identified 107 documents dating from 1974 to 2001, relating to safety culture/climate, or organizational culture/climate (Zhang, Wiegmann, von Thaden, Sharma, & Mitchell, 2002). Of these, 54 discussed organizational safety without reference to culture or climate. Twenty-three referred to organizational culture and/or organization climate without reference to safety. Thirty of these articles specifically referred to safety culture and/or safety climate. These 30 articles were used in our analysis.

Drawing from the commonalities in the identified articles, safety culture may be defined as, “The enduring value and priority placed on worker and public safety by everyone in every group at every level of an organization. It refers to the extent to which individuals and groups will commit to personal responsibility for safety, act to preserve, enhance and communicate safety concerns, strive to actively learn, adapt and modify (both individual and organizational) behavior based on lessons learned from mistakes, and be rewarded in a manner consistent with these values” (see Zhang, et al., 2002, for a thorough review of the relevant safety culture literature).

Organizational Indicators of Safety Culture

Formerly, there has been no consensus on the exact number of indicators that reflect an organization’s safety culture. Organizational indicators abound, with some estimates ranging from 2 to as many as 19 (Flin, Mearns, O’Connor, & Bryden, 2000). Several inconsistencies and frequent idiosyncratic labeling of these indicators makes it difficult to reconcile the range of organizational indicators identified in previous reports. However, a meticulous inspection of these various reports revealed that there are generally five global components or indicators of safety culture. They include Organizational Commitment, Management Involvement, Reward Systems, Employee Empowerment, and Reporting Systems (Wiegmann, Zhang, von Thaden, Sharma & Mitchell, 2002).

Organizational Commitment. An organization’s upper-level management has long been recognized as playing a critical role in promoting organizational safety culture (Dedobbeleer &

Beland, 1991; Flemming, Flin, Mearns, & Gordon, 1996; Flin et. al., 2000; Gordon, Flin, Mearns, & Fleming, 1996; Meshkati, 1997; Yule, Flin, & Murdy, 2001; Zohar, 1980, 2000). Organizational commitment to safety refers to the extent to which upper-level management identifies safety as a core value or guiding principles of the organization. An organization's commitment to safety is therefore reflected in the ability of its upper-level management to demonstrate an enduring, positive attitude toward safety, even in times of fiscal austerity, and to actively promote safety in a consistent manner across all levels within the organization. When upper-level management is committed to safety, it provides adequate resources and consistently supports the development and implementation of safety activities (Eiff, 1999). An organization's commitment to safety is therefore ultimately reflected by the efforts put forth to ensure that every aspect of its operations, such as equipment, procedures, selection, training, and work schedules, are routinely evaluated and, if necessary, modified to improve safety.

Management Involvement. Through participation in the day to day operations, both upper- and middle-level management communicate to their employees an attitude of concern for safety that subsequently influences the degree to which employees comply with operating rules and with safe operating practices (Eiff, 1999). Within the context of safety culture, "management involvement" refers to the extent to which both upper- and middle-level managers get personally involved in critical safety activities within the organization. Management involvement in safety, therefore, is reflected by managers' presence and contribution to safety seminars and training, their active oversight of safety critical operations, their ability to "stay in touch" with the risks involved in everyday operations and the extent to which there is good communications about safety issues, both up and down the organizational hierarchy.

Reward Systems. One of the key components of an organization's safety culture is the manner in which both safe and unsafe behavior is evaluated and the consistency in which rewards or penalties are doled out according to these evaluations (Reason, 1990). A fair evaluation and reward system is needed to promote safe behavior and discourage or correct unsafe behavior (Eiff, 1999). An organization's safety culture, therefore, is reflected by the extent to which it possesses an established system for reinforcing safe behaviors (e.g., through monetary incentives or public praise and recognition by management and peers), as well as systems that discourage or punish unnecessary risk taking and unsafe behaviors. However, an organization's safety culture is signified, not only by the existent of such reward systems, but also by the extent to which the reward systems are formally documented, consistently applied, and thoroughly explained and understood by all of its employees.

Employee Empowerment. Errors can originate at any level within an organization. However, frontline employees (e.g., pilots) often represent the last defense against such errors, thereby preventing accidents (Eiff, 1999). Organizations with a "good" safety culture empower their employees and ensure that employees clearly understand their critical role in promoting safety. Specifically, empowerment refers to an individual's perceptions or attitudes as a result of a delegation of authority or responsibility by upper-level management. An empowered attitude

can lead to increased motivation to “make a difference,” to go beyond the call of duty for organizational safety and take responsibility for ensuring safe operations (Geller, 1994). Within the context of safety culture, employee empowerment means that employees have a substantial 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.

Reporting Systems. “One of the foundations of a true safety culture is that it is a reporting culture” (Eiff, 1999). An effective and systematic reporting system is the keystone to identifying the weakness and vulnerability of safety management before an accident occurs. The willingness and ability of an organization to proactively learn and adapt its operations based on incidents and near misses before an accident occurs is critical to improving safety. Another important facet of a good reporting culture is “the free and uninhibited reporting of safety issues that come to the attention of employees during the course of their daily activities” (Eiff, 1999). Therefore, it is important to have a structured feedback system to inform the employees that the suggestion or concern had been reviewed and what kind of action will be taken to solve the problems. In summary, an organization with a good safety culture should have a formal reporting system in place and it is actually used comfortably by employees. The report system allows and encourages employees to report safety problems, and it also provides timely and valuable feedback to all employees.

The Commercial Aviation Safety Survey

Assessment Approach/Survey Development

After identifying the five parameters to assess organizational safety culture, we needed to find a way to measure them. Organizational assessment can take many forms, such as safety audits, one-on-one interviews and observations, checklists, error reporting forms, or surveys distributed to all operational personnel. Each form of assessment has positive and negative factors relating to its use such as time, cost, need for specialized personnel, etc. The survey approach is one of the most commonly used methods to assess safety-critical factors of high-risk organizations. This approach allows access to a large distribution and broad cross section of the population; respondents can remain anonymous; it allows for quick turnaround, and researchers can be viewed as a neutral, outside party without bias.

We identified questionnaire items from our previous investigation of the relevant organizational culture literature that could be used to measure the organizational dimensions of safety culture as it relates to flight operations (Wiegmann, Zhang, & von Thaden, 2001). We created a database of over 1,000 items we identified from various industries (transportation, oil, gas, mineral, nuclear, aviation, utilities and manufacturing) and grouped them by dimension (Wiegmann et. al., 2002). Table 1 lists the sources included in the database and the dimensions used by the original authors. We discarded those items that were not clearly applicable to safety

Table 1. Categorization of Items Used to Develop the Commercial Aviation Safety Survey

Article	Questionnaire Purpose	Original Dimensions
Anderson & West (1996)	Team Climate Inventory	Participative Safety - Information Sharing, Safety, Influence, Interaction Frequency. Support for Innovation – Articulated Support, Enacted Support. Vision – Clarity, Perceived Value, Sharedness, Attainability. Task Orientation – Excellence, Appraisal, Ideation. Social Desirability – Social Aspect, Task Aspect.
Bailey, Peterson, Williams, & Thompson (2000)	Pilot Perceptions of Flying Conditions (in Alaska)	Alaskan Pilot and FAA Official Interaction Organizational Influences - Resource Management – Human/Money/Equipment Organizational Influences - Organizational Climate—Structure/ Policies/Culture Organizational Influences - Organizational Process – Operations/Procedures/Oversight Unsafe Supervision - Unforeseen - Unrecognized Hazardous Operations/ Inadequate Documentation Procedures Unsafe Supervision - Known - Inadequate Supervision/ Planned Inappropriate Operations/ Failed to Correct Problem Preconditions for Unsafe Acts - Substandard Conditions--Adverse Mental States/ Adverse Psychological States/ Physical/Mental Limitations Preconditions for Unsafe Acts - Substandard Practices of Operators - Interpersonal Resource Mismanagement/Personal Readiness/ Unsafe Acts - Errors - Decision Error Violations – Routine
Bureau of Air Safety Investigation (1996)	Safety Culture and Hazard Risk Perception	No subdimensions
Ciavarelli & Figlock (1996)	Command Safety Assessment	Process Auditing, Reward System, Quality, Risk Management, Command and Control
Cox & Cox (1991)	Attitudes to Safety	Personal Skepticism, Individual Responsibility/Effectiveness of Arrangements for Safety Safeness of Work Environment, Individual Responsibility, Safeness of Work Environment/Effectiveness of Arrangements for Safety, Personal Immunity
Dastmalchian, Blyton, & Adamson (1989)	Industrial Relations Climate	Harmony, Apathy, Hostility, Openness, Promptness
Dedobbeleer & Beland (1991)	Safety Climate	Management’s Attitude Toward Safety Practices, Management’s Attitude Toward Workers’ Safety, Foreman’s Behavior, Safety Instructions, Safety Meetings, Proper Equipment, Perceived Control, Perception of Risk-Taking, Perceived Likelihood of Injuries
Desatnick (1986)	Management Climate	Management Climate, Worker Climate
Idaho National Engineering and Environmental Laboratory	Total Safety Culture (description)	Worker Involvement, Management Commitment to Safety, Personal Accountability, Performance Management, Coworker Support, Training, Equipment, Physical Environment, Organizational Commitment, Job Satisfaction
Idaho National Engineering and Environmental Laboratory	Total Safety Culture - Interview	Background, Training, Management Leadership, Top Management Involvement, Hazard Correction, Complaints, Health Program, Personal Protective Equipment (PPE), The Employee Safety Team, VPP Participation, General
Janssens, Brett, & Smith (1995)	Perceptions of Safety Level	Management’s Overall Concern, Production as a Priority, Safety as a Priority, Perceived Safety Level
Kivimaki, Kuk, Elovania, Thomson, Kalliomaki-Levanto, & Heikkila (1997)	Team Climate	Vision, Task Orientation, Support for Innovation, Participative Safety, Interaction Frequency
Mueller, DaSilva, Townsend, & Tetric (1999)	Safety Climate	Workplace, Social, Incentives, Attitude
NASA NonSupervisory Employee Safety Performance Survey (1998)	Safety Performance	Visible Management Leadership, Employee Participation, Implementation Tools, Survey and Hazard Analysis, Inspection, Reporting, Mishap Investigation, Data Analysis, Hazard Control, Maintenance, Medical Program, Emergency Preparedness, First Aid/Emergency Care, Safety and Health Training
Frikken/Nuclear Safety Bureau (1997)	Regulatory Influence on Safety Culture	Methods of the NSB, Impact of the NSB, HIFAR/NSB Interface, Level of Competence
Ostrom, Wilhelmsen, & Kaplan (1993)	Safety Norms	Safety Awareness, Teamwork, Pride & Commitment, Excellence, Honesty, Communications, Leadership & Supervision, Innovation, Training, Customer Relations, Procedure Compliance, Safety Effectiveness, Facilities
Pizzi, Goldfarb, & Nash (2001)	Patient-Safe Environment	No subdimensions

Prosafe Solutions, Inc.	Organizational Safety Culture	No subdimensions
Rakovan, Wiggins, Jensen, & Hunter (1999)	Dissemination of Safety Information	Use of Aviation Safety Information, Seminars, Computer/Video Use, Self Assessment, Stress Factors, Recent Flying Experience, Personal Information
Rybowiak, Garst, Frese, & Batinic (1999)	Error Orientation	Error Competence, Learning From Errors, Error Risk Taking, Error Strain, Error Anticipation, Covering Up Errors, Error Communication, Thinking About Errors
Schriber & Gutek (1987)	Temporal Dimensions of Work	Schedules and Deadlines, Punctuality, Future Orientation & Quality vs. Speed, Allocation of Time, Time Boundaries Between Work and Nonwork, Awareness of Time Use, Work Pace, Autonomy of Time Use, Synchronization and Coordination of Work With Others Through Time, Routine vs. Variety, Intraorganizational Time Boundaries, Time Buffer in Workday, Sequencing of Tasks Through Time
Yule, Flin, & Murdy (2001)	Safety Climate	Upper Management Commitment to Safety, Implementation of Procedures, Health and Safety Knowledge, Team Cohesion, Team Leader Involvement, Individual Responsibility, Permit-to-Work, Accountability
Zohar (2000)	Group Safety Climate	Action, Expectation

culture or that were not appropriate for our format (e.g., open-ended items asking respondents to describe an unsafe incident). The full text of the questionnaires from which our final items were drawn appears in Appendix A.

After identifying the survey items, we began the laborious process of grouping and regrouping the items, removing redundant items, rewording items, and achieving consensus among researchers to develop a safety culture survey. The remaining items were clustered around the five categories of Organizational Commitment, Management Involvement, Reward Systems, Employee Empowerment, and Reward Systems. Next, items within each of the categories that were very similar were identified and the less preferred phraseology deleted. The remaining items were reworded to pertain to aviation, then re-examined to remove similar items across categories. The items were then put into a survey format to include a 7-point Likert scale and an area for comments on each of the items identified. Subject matter experts supplied feedback regarding the items on the questionnaire and their appropriateness to include in a survey of commercial airline pilots and management. Once their feedback was received, the items were revised and again consensus on the survey achieved, resulting in an 81-item, Commercial Aviation Safety Survey (CASS) (see Figure 1 for an illustration of this process).

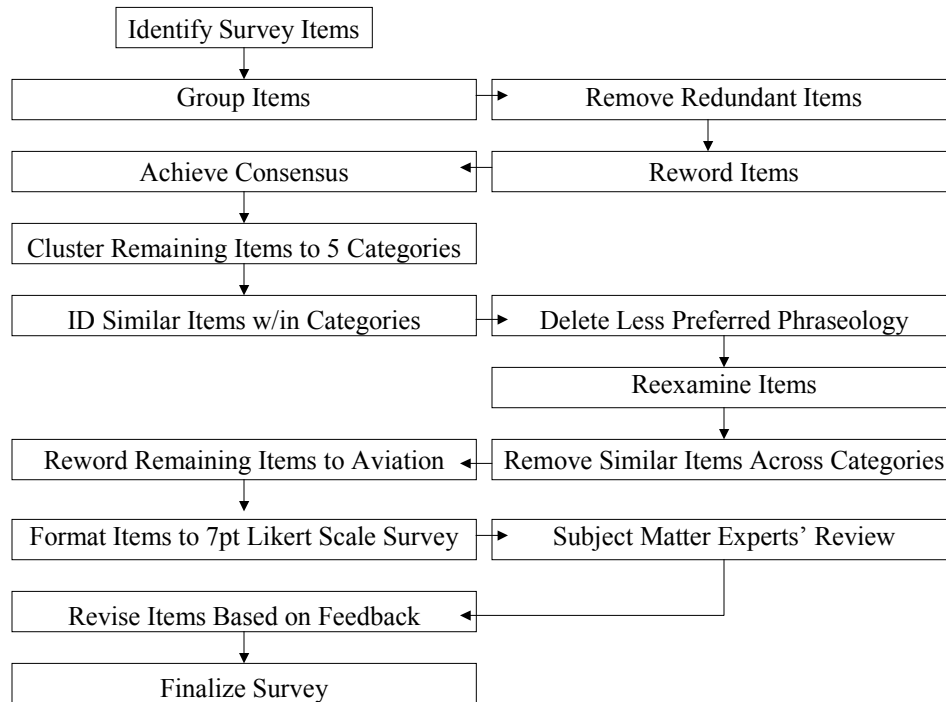


Figure 1. Process for development of CASS.

Validation Issues/Perceived Risk Items

Several issues concerning the validation of a safety culture survey exist. One of the most important issues is discriminant validity, which refers to the power of a safety culture measurement tool to differentiate between organizations or groups that actually possess different levels of safety. One of the most obvious criteria for differentiating between organizations is the number of accidents, incidents and near misses experienced by an organization. However, within high-reliability organizations, such as commercial aviation, accidents and incidents are so infrequent that they produce a highly skewed distributed that cannot be used statistically to differentiate different levels of safety across organizations. Griffin and Neal (2000) in their search for other sources of objective safety data have proposed using safety compliance behavior and employee participation in voluntary safety activities in meetings. Still, given the difficulty in obtaining objective validation criteria, most studies have relied on the use of subjective data, such as employees' perceived risk of the working environment or expert ratings of an organization's safety level.

To address these issues, we included five additional items in CASS to assess respondent's perceptions of the likelihood of an accident or incident occurring either to themselves or within their organizational in general over a 12 month period. After these *perceived risk* items were added, the final CASS consisted of 86 items. All of these items can be found in Appendix B.

Note that for presentation purposes, items have been grouped according to category. However, they were randomly ordered in the actual survey.

Initial Validation Study

As an initial attempt to validate this survey, we identified a regional airline that possessed an industry reputation for safety and employee friendly relations and asked for their participation in filling out an anonymous safety culture survey. Management was receptive and enthusiastic about the chance to participate in this research endeavor. A draft version of the CASS was shared among the top administrators for input regarding specific item wording, as it would pertain to their airline, and any suggestions they might have regarding the applicability of the questions to their type of operations. We received feedback from the airline and incorporated many of their suggestions. We also tailored the instructions slightly to match their definitions of managerial personnel within their organization.

Participants

One hundred and eight Commercial Aviation Safety Surveys were distributed to 93 pilots and 15 management/supervisory personnel at a regional, FAR Part 135 scheduled air carrier. A copy of the survey was placed in each employee's mail folder where they receive their paycheck. A letter from senior management accompanied the survey, explaining the organizational and research purposes of the survey, encouraging employees to participate. We also included a letter explaining the purpose of this research, assuring anonymity, and provided a stamped, addressed envelope to the participants so they could return the surveys, directly and anonymously, to the University of Illinois' Aviation Human Factors Division. Participation was completely voluntary, and no monies were paid to respondents.

Of the 108 surveys distributed, 43 (40%) were returned. All surveys returned were in usable condition and included in the analysis. Thirty-five respondents (81%) described their primary job responsibility as "Line Pilot", while six described their positions as "Manager/Supervisor" or "Other" and two declined to provide this information.

We included a demographic section at the end of the survey to provide additional information about the respondents. To preclude identification of individual pilots based on age or job tenure data, participants were asked to indicate the appropriate age or tenure bracket among a group of ranges we supplied, rather than provide an exact figure. Most respondents (86%) were male, 7% female, and 7% did not provide gender information. The majority of respondents (56%) were between 31 and 50 years of age. Most (74%) had been employed by the airline between 1 and 10 years, with 59% indicating that they had held their present position for 5 years or fewer. Seventy percent of the respondents indicated that they had reported a safety problem at some point in their career at the airline.

Scale Reliability

In psychometric terminology, *reliability* refers to the consistency or replicability of a set of test or questionnaire items. A reliable scale is one that will yield the same score for two different individuals with the same true level of the trait or attitude being measured, or for one individual tested twice (assuming that no changes have occurred between tests). Within a scale, items assessing the same underlying dimension are related or correlated with one another. A common measure of reliability is the Guttman-Cronbach alpha coefficient (Cronbach, 1951; McDonald, 1999), which is based on the correlations between the items in a scale and the length of the scale. Alpha coefficients derived from the airline's data for the five safety culture scales are provided in Table 2. The value of alpha can range from zero to one, but standards regarding its size depend on a number of factors, including the nature of the research and the degree to which scale items are redundant (Nunnally, 1967; John & Benet-Martinez, 2000). As this was an initial test of the survey, rather than the presentation of a finished product, and as every attempt was made during the survey development process to eliminate redundant items, the obtained values of alpha for all five scales appear to demonstrate adequate reliability.

Table 2. Reliability of Survey Subscales

Scale	# of items	Alpha
Organizational Commitment	27	0.94
Management Involvement	18	0.90
Reward System	9	0.71
Employee Empowerment	14	0.81
Reporting System	13	0.86

Item Level Analysis

Though the initial reliability of all five dimensions was acceptable, item-level analysis indicated that some items correlated only weakly or even negatively with other items in the scale. Several items were identified by analysis software (SPSS) as actually reducing the reliability of the scale. Removing these items produced slight gains in reliability for most scales, with a substantial increase in the reliability of the Reward System. However, negative inter-item correlations still appeared for a number of items.

An additional goal of the reliability analysis was to determine whether the scales could be shortened without substantial loss of reliability. The survey administered to the airline personnel contained 86 items and was five pages long. This may have seemed overly long and burdensome to respondents, particularly since they were asked to complete the survey on their own time. A shorter instrument would be more efficient for both administration and analysis. With this goal in mind, the ten best-performing items from each scale were selected and reassessed for reliability.

Items were selected based on the item-total correlation coefficient, which measures the relationship between an individual's score on the item and his or her total score on the scale. Items that correlated negatively with any other item in the scale were excluded. The remaining items appear in Appendix C. Table 3 compares the alpha reliability coefficients for the original sets of 81 items, the edited sets of items (as described in the paragraph above), and the ten-best items scale. The abbreviated (ten-item) scales do not appear to be less reliable than the edited scales to any appreciable degree. In fact, these scales have a slight advantage over the others in that all items in the abbreviated scales are positively correlated. The abbreviated scales appear to measure the concepts of interest at least as well as the original full-length survey.

Table 3. A Comparison of Alpha Coefficients for Original Item Scales

Scale	Original		Edited		10-Item	
	Items	Alpha	Items	Alpha	Items	Alpha
Organizational Commitment	27	0.94	24	0.95	10	0.94
Management Involvement	18	0.90	17	0.91	10	0.91
Reward System	9	0.69	6	0.81	6	0.81
Employee Empowerment	14	0.81	12	0.83	10	0.83
Reporting System	13	0.87	12	0.87	10	0.87

Inter-Scale Correlations

The correlation analysis indicated that scores of the five dimension scales were highly interrelated. The exact correlations are given in Table 4.

Table 4. Interscale Correlations of the Dimensions of Safety Culture and Perceived Risk

Scale	OC	MI	AS	EE	RS	OR	IR
Organizational Commitment	1.00						
Management Involvement	.911	1.00					
Reward System	.643	.620	1.00				
Employee Empowerment	.745	.672	.690	1.00			
Reporting System	.796	.848	.440	.564	1.00		
Organizational Risk	-.569	-.569	-.559	-.493	-.402	1.00	
Individual Risk	-.005	-.042	.072	-.012	-.025	.147	1.00

Correlations in **bold** type are significantly different from zero ($p < 0.01$).

While it was expected that some correlation would exist between the five dimensions of safety culture, the large size of the observed correlations suggests that the survey may have measured fewer distinct dimensions than intended. In particular, the correlation between the Organizational Commitment and Management Involvement scales is close to unity, implying that these two scales are actually measuring a single construct. In addition, the average inter-item

correlation between Organizational Commitment and Management Involvement items was 0.35, while the average inter-item correlation among Organizational Commitment items was 0.34 and that between Management Involvement items was 0.36. In other words, the Organizational Commitment items are approximately as closely related to the Management Involvement items as to one another.

While this suggests that Management Involvement and Organizational Commitment may be two names for the same basic construct, it is not possible at this time to draw a definitive conclusion from the available data. The small sample size (43 respondents) compared to the number of items in the survey precludes conducting a factor analysis to determine the structure of the data. In addition, the initial conceptual distinction between Organizational Commitment and Management Involvement was such that Organizational Commitment referred to the priority placed on safety by senior management, reflected in the policies of the organization as a whole, while Management Involvement referred to the personal involvement of supervisory-level managers in safety concerns. For the airline used in this study, the organization chart is relatively flat so it is reasonable to expect that perceptions of top management and perceptions of one's immediate supervisor would be highly similar. Further, the wording of the instructions in the survey was such as to encourage pilots to consider both senior management and their immediate supervisors whenever the word "management" was used. In a larger or more vertical organization, however, the distinction between Management Involvement and Organizational Commitment might become apparent. It remains plausible that supervisory-level managers' personal involvement in safety could differ substantially from the safety commitment of the organization's policy-makers. In light of these considerations, it seems most appropriate to retain Organizational Commitment and Management Involvement as separate dimensions for the present and clarify the wording of these items for future use.

The perceived risk measures were originally intended to constitute a single measure of perceived risk. Upon analysis, the pattern of correlations between the items indicated that the items could be divided into two distinct categories: perceived organizational risk and perceived personal risk. The former items deal with the likelihood that the *airline* will be involved in an accident or incident, while the latter consider the probability that the *individual respondent* will be involved. The correlation between perceived organizational risk and personal risk is 0.15 and does not meet conventional criteria for statistical significance, which suggests that the two concepts are unrelated. Both scales demonstrate acceptable reliability, so it is appropriate to treat them as distinct measures.

Dimension Scores

Performance scores for the airline on each of the five dimensions of safety culture (Organizational Commitment, Management Involvement, Reward System, Employee Empowerment, and Reporting System) were determined by calculating the mean of the

participants' responses to the items in each scale. Means for each dimension scale appear in Figure 2. Responses were given on a seven-point Likert scale, ranging from 1-"strongly disagree," to 7-"strongly agree," with 4 representing "neither agree nor disagree." Negatively worded items (such as "My airline is more concerned with making money than being safe.") were recoded before averaging so that higher scores on all items reflected a positive response. The possible range of values for each scale, then, ranged from 1 (indicating an extremely negative view of the dimension) to 7 (indicating an extremely positive view of the dimension). A scale score of 4 would reflect either mixed views (an equal number of positive and negative responses) or neutrality (neither agreeing nor disagreeing with any item).

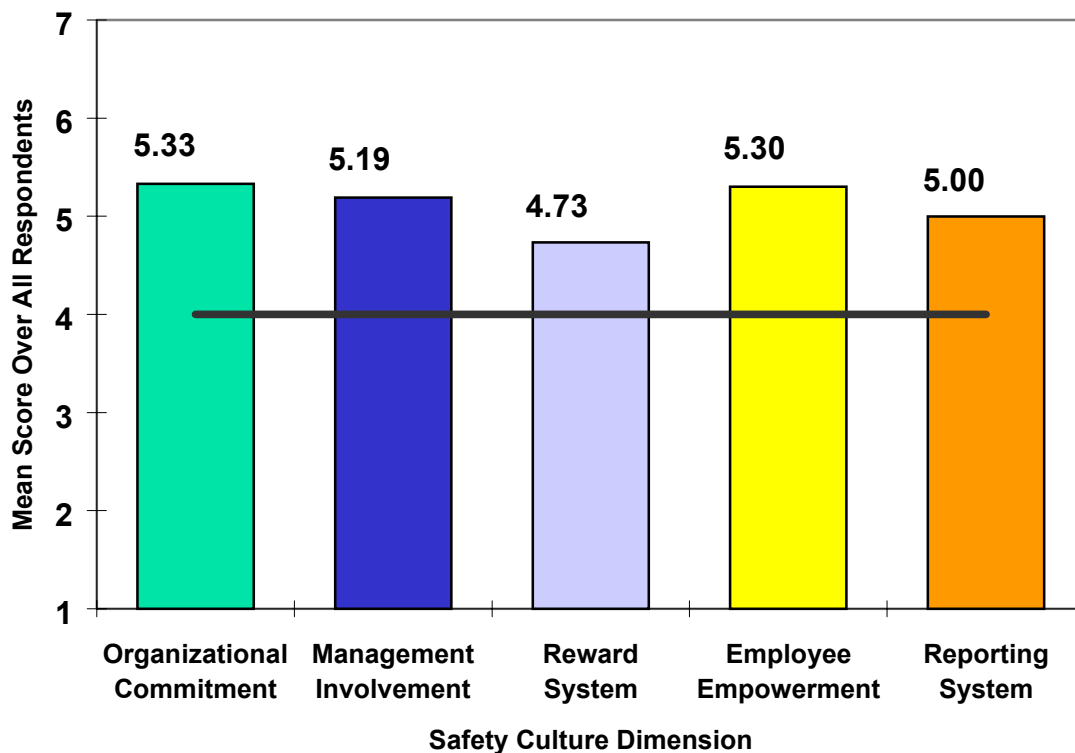


Figure 2. Mean airline scores on the five dimensions of safety culture. The horizontal line indicates the scale midpoint of 4. Scores are considered positive when above this value and negative when below.

The mean score for the airline on all five dimensions was above the neutral point, indicating that respondents hold a generally positive opinion of their airline's safety culture in regard to each dimension (Table 5). However, considerable variability within most scales suggests that not all of these airline employees view the airline's safety culture in the same light. In fact, while some employees indicated a very positive view of the airline's performance on the various dimensions, other employees indicated a negative view of some aspects of the existing safety culture. No dimension received a perfect score from any employee (i.e., endorsing the

appropriate “strongly agree/disagree” alternative for all items in the scale), and no dimension received a completely positive score from all employees. No individual employee gave negative scale scores for all five dimensions (though one individual’s highest scale score was a neutral 4), and only one gave scale scores above 6 on all dimensions. This suggests that while the airline is doing reasonably well in all five areas, there is room for improvement in each.

Table 5. Means and Ranges of Dimension Scores

Scale	Mean	Minimum	Maximum
Organizational Commitment	5.33	3.04	6.81
Management Involvement	5.19	1.88	6.83
Reward System	4.73	2.44	6.88
Employee Empowerment	5.30	3.64	6.86
Reporting System	5.00	3.00	6.46

Organizational Commitment

Further information regarding strengths and weaknesses within each dimension can be obtained by examining ratings on individual items within the scale. An average item score of 6 or higher indicates that nearly all respondents endorsed the item positively, implying that the airline displays a strong positive safety culture in that area. An average score below the scale midpoint of 4 indicates that most respondents endorsed the item negatively, suggesting an area in which the airline may need to improve.

For Organizational Commitment, several items had average ratings of 6.0 or higher. These include:

- “My airline’s manuals are up-to-date” (6.37)
- “Safety is always discussed during training at my airline” (6.29)
- “Checklists and procedures are easy to understand” (6.19)
- “I am confident that maintenance on aircraft is adequately performed and that aircraft are safe to operate” (6.16)

Respondents seem to agree that manuals and checklists are of high quality, that safety is emphasized in training, and that maintenance is appropriately performed. The emphatic nature of these scores indicates that these are areas of particular strength for the airline. By contrast, the item “Management is committed to equipping aircraft with up-to-date technologies” received only an average score of 3.42. Most respondents did not agree with this item, suggesting that organizational commitment to equipment and technology issues could be improved. However, it must be noted that the technology in aviation operations changes quickly and keeping pace with the latest instrumentation is a nearly impossible task (and not altogether necessary as technologies in place in the aircraft are adequate).

Further insight into challenge areas may be gained from the comments provided by respondents. The survey provided space for comments beside each survey item and encouraged respondents to comment as much as they desired. It is worth noting that negative or constructive comments often occur more frequently than positive comments in survey research of this kind, as individuals with concerns have a greater incentive to comment than those content with the status quo. Comments obtained from the Organizational Commitment items indicate several very specific areas for improvement (e.g., fuel policy, opening of baggage hatches). Several respondents, in keeping with the low overall score reported for this item previously, addressed technology and equipment issues. A general trend of inconsistency is also apparent from the many instances in which contradictory comments were obtained for the same item (e.g., sleep schedules, pushing the weather). It appears that pilots within the airline can have widely varying experiences with, and perceptions of, the organization’s commitment to safety. Transcriptions of all relevant comments for the organizational commitment dimension appear in Table 6. Comments were edited only when there appeared a possibility of identifying a respondent based on the content of the comment. Comments pertaining to the design of the survey (rather than the content of the items) were excluded.

Table 6. Respondent Comments for Organizational Commitment Items

Item Text	Comment	Source
Management doesn’t show much concern for safety until there is an accident or incident.	Company is reactive, not proactive.	Line Pilot (P 22)
Safety is identified as a “core value” in my airline.	In name, by management. In practice, by 80% of pilots.	Line Pilot (P 6)
	Never heard that phraseology.	Line Pilot (P 26)
	Part of our company mission statement.	Manager (M 30)
Checklists and procedures are easy to understand.	We fly a very simple aircraft.	Line Pilot (P 6)
	Autopilot test procedures difficult.	Line Pilot (P 26)
Management expects pilots to “push” the weather.	“Push” never heard that.	Line Pilot (P 26)
	Always.	Line Pilot (P 6)
Management tries to get around safety requirements whenever they get a chance.	Management encourages minimum fuel to be carried on board.	Line Pilot (P 4)
Management is willing to invest money and effort to improve safety.	Payload & performance will not allow single engine climb out performance.	Line Pilot (P 4)
Training practices at my airline are centered around safety.	No simulator based recurrent training.	Line Pilot (P 4)
Some safety procedures/rules are not really practical.	Particularly, when ramp personnel open baggage hatches.	Line Pilot (P 26)

Item Text	Comment	Source
Safety is always discussed during training at my airline.	Unfortunately once training is completed the daily grind is supportive of ignoring or bending rules to save time or money.	Line Pilot (P 6)
It is hard for pilots here to maintain a consistent sleep schedule.	Irregular and inconsistent show times.	Other/Not Given(O3)
	Work schedule pretty good for sleep.	Line Pilot (P 22)
	Look at schedules.	Line Pilot (P 26)
My airline does all it can to prevent accidents or incidents.	Company goes for money most of the time.	Line Pilot (P 22)
When an accident occurs, management always blames the pilot.	Not until *all* factors are looked at - then maybe.	Line Pilot (P 37)
	Company president said this in pilot meeting.	Line Pilot (P 22)
Management is committed to equipping aircraft with up-to-date technologies.	Director of maintenance takes all non required items out of aircraft when they are written up - yaw damper, prop sync, TAS indicators.	Line Pilot (P 22)
	It makes no sense to me to not have a GPS in this day and age.	Line Pilot (P 35)
	No TCAS, no radar altimeters, older radios.	Line Pilot (P 26)
Pilots who are not feeling well or are tired are encouraged not to fly.	Crew schedulers are not pilots and do not seem to understand this concept.	Other/Not Given(O3)
	Pilots who won't fly after long duty days are called to chief pilot's office and asked why they didn't get enough sleep.	Line Pilot (P 22)
	An IOE check airman was asked if he needed retraining after he did an ILS to minimums that he wasn't happy with because he was tired. He went home. Operations reported him to D.O. The D.O. asked him about retraining. Sounds more like intimidation.	
When it comes down to it, people in this airline would rather take a chance with safety than cancel a flight.	With low, low weather.	Line Pilot (P 26)

Comment source in parentheses () P=Pilot, M=Manager, O=Other/Not Given

Management Involvement

The average score on Management Involvement was 5.19. No items in this scale received consistently high ratings (item average of 6 or higher), though the item “Management involvement in safety issues has a high priority at my airline” received a score of 5.95. Two items in this scale had negative average ratings:

“Results of FAA safety inspections are made available to pilots for review and information.” (3.54), and

“Management often fails to recognize when pilots are flying unsafely.” (3.79)

While respondents agree that management seeks to be involved in safety, the lower-scoring items suggest that the communication necessary to make that involvement effective may not always be in place. Respondent comments about the Management Involvement items also indicate that improving two-way communication between pilots and managers may be desirable. Some respondents display cynicism about the depth and sincerity of managers’ safety involvement. The text of all relevant comments pertaining to Management Involvement is given in Table 7.

Table 7. Respondent Comments for Management Involvement Items

Item Text	Comment	Source
Management involvement in safety issues has a high priority at my airline.	CYA.	Line Pilot (P 19)
	Company likes to talk and blame individuals and not the system in which they work.	Line Pilot (P 22)
My airline’s safety department is doing a good job.	They’re trying.	Line Pilot (P 6)
Management has a clear picture of the risks associated with flight operations.	They think they do because many are pilots but they only fly in great weather with the cherry airplane of their choosing, usually going to/from meetings. Not flying ‘the Line’.	Line Pilot (P 6)
	Poor single engine aircraft performance.	Line Pilot (P 4)
Management stops unsafe operations or activities.	Only if there is practically a revolt!	Line Pilot (P 6)
There are good communications here about safety.	Lots of communicating - little response. Class D airspace with no radar, very busy during the summer, a mid air waiting to happen. I [made a suggestion] to increase safety in this high-risk environment [which was ignored]. Nothing has changed.	Line Pilot (P 22)
	Need a dedicated spot for safety resources and information.	Manager (M 1)

Comment source in parentheses () P=Pilot, M=Manager, O=Other/Not Given

Reward System

Reward System received the lowest score of the five dimensions, with an average of 4.73. As with Management Involvement, no item scored above 6.0, and the highest-scoring item was “Being involved in an accident or incident has an adverse effect on a pilot’s reputation,” which had an average score of 5.74. Only one item, “Being involved in an accident or incident has an adverse effect on a pilot’s future with this airline,” had a negative average score, at 3.60. The narrow range between the highest- and lowest-scoring items implies that the Reward System items are largely clustered just above the neutral point of the scale. The contrast between these two very similar items suggests that informal or peer consequences for unsafe behavior may be very different from formal organizational consequences. Similarly, respondent comments point to inconsistency in the way consequences for unsafe behavior are administered. The transcribed comments appear in Table 8.

Table 8. Respondent Comments for Reward System Items

Item Text	Comment	Source
Being involved in an accident or incident has an adverse effect on a pilot’s future with this airline.	On the contrary - then they figure you’ll never get another job and now they’ve got you by the short hairs.	Line Pilot (P 6)
	Company forgives many pilots for *bad* decisions.	Line Pilot (P 22)
Airline management negatively evaluates pilots who behave recklessly.	If reckless behavior is saving money or done by a “favored son” it is either shrugged off or rewarded.	Line Pilot (P 6)
Pilots shouldn’t expect praise and recognition for complying with safety regulations, because safety is part of the job.	At my airline, this is true.	Line Pilot (P 26)
Pilots who cause accidents or incidents are not held sufficiently accountable for their actions.	Depends on whether management likes you or not.	Line Pilot (P 6)
Our reward system promotes high performance even if it means acting unsafely.	We have no reward program.	Line Pilot (P 26)

Comment source in parentheses () P=Pilot, M=Manager, O=Other/Not Given

Employee Empowerment

Employee Empowerment had an average score of 5.30, making it the second-highest scoring dimension. The item “Pilots do all they can to prevent accidents” was the strongest item in this category with an average score of 6.09. The only negative-scoring item was “Pilots are

seldom asked for input when airline procedures are developed or changed,” which received an average score of 3.55. Comments in this section echo those reported for the reward system items, indicating a discrepancy between organizational and peer consequences for unsafe actions. These comments are reported in Table 9.

Table 9. Respondent Comments for Employee Empowerment Items

Item Text	Comment	Source
Pilots are actively involved in identifying and resolving safety concerns.	Identifying - yes - resolving - no.	Line Pilot (P 6)
	The feeling I get is don't ask questions; just do what you're told.	Line Pilot (P 22)
Pilots look at the airline's safety record as their own and take pride in it.	Our safety record has been damaged by foreseeable events that were recognized by experienced line pilots but ignored by management.	Line Pilot (P 6)
Pilots who violate safety regulations upset other pilots even when no harm has resulted.	Pilots who violate safety regulations are rewarded - if they save time and/or money. They are quickly abandoned by the company if the violation is made known to FAA.	Line Pilot (P 6)
Peer influence is effective at discouraging violations of operating procedures and flying regulations.	Lots of violators. Company likes it if it saves money.	Line Pilot (P 22)
Pilots try to get around safety requirements whenever they get a chance.	Good example is repositioning aircraft to maintenance while broken.	Line Pilot (P 22)
	Some do, and they are rewarded.	Line Pilot (P 6)
It is important for me to fly safely if I am to keep the respect of other pilots in my airline.	Especially my self respect!	Line Pilot (P 6)

Comment source in parentheses () P= Pilot, M= Manager, O= Other/Not Given

Reporting System

Reporting System received a moderately positive average score of 5.0. Respondents strongly endorsed items regarding the availability of the airline's safety reporting system:

“I am familiar with the system for formally reporting safety issues in my airline” (6.42)
 “This airline's safety program includes mechanisms for me to report safety deficiencies” (6.33)

Employees clearly indicated that they are aware of the reporting system, but two items about their willingness to use it received negative scores:

“Pilots do not report their own mistakes when they are not obvious.” (3.12)

“It is best to remain anonymous when reporting an unsafe condition or incident.” (3.81)

Some pilots may expect negative repercussions from reporting certain types of errors or safety concerns, though this expectation does not appear to be universal (the item “Pilots can report safety discrepancies without the fear of negative repercussions” received a positive average score of 5.4). Comments on the Reporting System items (Table 10) support this notion, though this dimension received the fewest comments of the five scales. Further investigation may be necessary in order to determine whether the reporting system encourages open and honest reporting consistently throughout the organization.

Table 10. Respondent Comments for Reporting System Items

Item Text	Comment	Source
Pilots are willing to report information regarding safety violations, marginal aviator performance, or other unsafe behavior.	Usually the 1st time that happens they are punished by management and scheduling and station operations.	Line Pilot (P 6)
Pilots who raise safety concerns are seen as troublemakers.	By other pilots.	Line Pilot (P 14)
Pilots who admit their errors make a big mistake.	Doesn't really matter - any problem is ALWAYS blamed on the pilot.	Line Pilot (P 6)
I am satisfied with the way this airline deals with safety reports.	Director of safety does a good job.	Line Pilot (P 22)

Comment source in parentheses () P=Pilot, M=Manager, O=Other/Not Given

General Comments

Space was provided at the end of the survey for respondents to indicate any additional thoughts or concerns. Those comments appear in Table 11 in their entirety.

Table 11. General Comments

General Comments	Source
1. Biggest problem last two years was hiring substandard/inexperienced applicants because of pilot shortage. Our accidents were because of this. 2. Long schedules, too many legs (up to 12-22/day), mix of early and late show times & end times disruptive. 3. Older radios, no TCAS, no Radar Altimeters, aircraft without de-ice and weather radar.	Line Pilot (P 26)
The airline says not to take calculated risks but they do and expect pilots to fly unsafe aircraft. You are deemed a “ramble rouser” for speaking out against these practices.	Other/Not Given (O 8)
1. This company will go for the money most of the time over flight safety. 2. Substandard pilots are pushed through and given too many chances. This has a negative effect on the standing of the pilot group in the eyes of the company at large. This breeds a culture where safety is not absolute and flight ops, station ops, and maintenance ask for unsafe things from pilots on a regular basis. Weak pilots and competing interests from company personnel outside the pilot group contribute negatively to fostering a good safety culture. I think what this group needs is a separate identity from the rest of the company. The company likes to put all of its employees on a level playing field. The “we’re all in this together” thing doesn’t work. I believe it’s not the job of the pilots to deliver profits. We should deliver and be rewarded for safely operating the airline’s equipment. An equal weighing of profits vs. safety has put us in a tough spot w/ 3 almost fatalities in a little over 1 year. Let the other folks in the company make the profits. This airline needs to deliver flight safety if it is going to survive. Quality pilots paid a livable wage and a safety first work environment are the only solutions.	Line Pilot (P 22)

Comment source in parentheses () P=Pilot, M=Manager, O=Other/Not Given

Perceived Risk

In the context of this survey, perceived risk is both an outcome (do employees perceive this airline as safe?) and a criterion (do employees’ perceptions of safety culture predict their overall perception of risk?). As an outcome, employees’ perceptions of organizational risk are largely neutral and their perceptions of personal risk negligible. The average score on the organizational risk items was 3.87, just short of the 4.0 neutral point. While this indicates a reasonably low degree of perceived organizational risk (lower scores here indicate a safer environment), comments by respondents suggest that many were reluctant to make forecasts about what they viewed as a complex and unpredictable phenomenon, often choosing 4.0 to abstain from making a prediction. Overall, however, responses were generally normally distributed across the entire response range from 1.0 to 7.0, indicating considerable diverse opinions about the likelihood of an accident or incident at the airline in general.

By contrast, there was little diversity of opinion among respondents with respect to perceived individual risk. With an average score of 1.65, 58% of the respondents indicated that they “strongly disagree” that they personally are likely to be involved in either an accident or incident. No respondent endorsed either of these items positively; the maximum score was the neutral point 4.0. This result is not particularly surprising, since much social psychological research supports the notion that individuals are often overconfident in their own abilities and attribute desirable characteristics (such as being safe) to themselves more than to others (e.g., Dorn & Matthews, 1995). It is hardly likely that pilots would actively expect to be involved in an accident or incident, especially when they believe they have some measure of control over such an outcome.

Perceived risk in the criterion sense refers to the degree with which we can predict a respondent’s perceptions of risk from the five safety culture dimensions. Knowing which dimensions are most strongly related to perceived risk suggests an area of focus to improve risk perceptions and indicate the relative importance of each dimension to the overall safety culture. At this airline, the perceived organizational risk scale (Table 12) was significantly negatively correlated with all five of the dimension scales, indicating that higher dimension scores are related to lower perceived risk.

Table 12. Correlations Between Perceived Organizational Risk and the Five Dimensions of Safety Culture

Perceived Organizational Risk and Organizational Commitment:	-0.57
Perceived Organizational Risk and Management Involvement:	-0.57
Perceived Organizational Risk and Reward System:	-0.56
Perceived Organizational Risk and Employee Empowerment:	-0.49
Perceived Organizational Risk and Reporting System:	-0.40

All correlations are significantly different from zero ($p < 0.01$).

A regression equation containing all five dimension scales as predictors was able to account for 41% of the variance in organizational risk scores ($R = 0.639$, $R^2 = 0.409$, $p = 0.001$). However, previous analysis revealed high correlations between the predictor variables, implying that not all five dimensions were providing unique information. A regression equation including organizational commitment alone accounted for 32% of the variance ($R = 0.569$, $R^2 = 0.324$, $p < 0.001$), and adding reward system as a predictor accounted for an additional 6.3%, for a total of 39% ($R = 0.622$, $R^2 = 0.387$, $p = 0.049$). This is nearly as good as the model involving all dimensions and includes less redundancy among predictor variables.

Refining the Survey

While one purpose of the survey was to provide the airline with information regarding the nature and quality of their safety culture, a second purpose was to develop a general measurement instrument that could be used to assess safety culture in a variety of airlines. While many of the items in the survey were derived from previous measures of safety culture, they had not been tested in conjunction with one another or according to the five-dimension theory of safety culture. The survey data and respondent comments from the airline were used to refine and modify the scales for future use.

Towards a Measure of Safety Culture

The present study provides empirical support for the Commercial Aviation Safety Survey as an index of airline safety culture in flight operations. Although further work is needed to refine the measure and establish its validity in a more general population, this initial test answers several necessary questions about the survey items and lays solid groundwork for future development.

On the most basic level, the survey at the airline indicated that responding pilots understood the items and considered them relevant. No item was omitted or designated “not applicable” by more than three pilots, though respondents were expressly instructed to identify items that did not apply to their current position. Some comments suggested potential problems with the wording of individual items, which can be incorporated into future versions, but these comments were minimal. In all, it does not appear that the pilots who responded had difficulty completing the survey.

All five scales were found to demonstrate appropriate reliability, both in their entirety and in abbreviated form. Reliability analysis suggested that the scales could be substantially shortened without appreciable loss of reliability. The content of items in each abbreviated scale (i.e., the most intercorrelated items) appears to reflect the conceptual definition of the corresponding dimension, but it was not possible to conduct formal tests of the structure of the data (factor analysis) due to the low sample size. High correlations between scales suggest that fewer than five dimensions may actually exist in the data, though again this could not be tested without factor analysis. Organizational commitment and management involvement appeared to be a single dimension in this sample, but it is difficult to determine whether this represents a truly unitary construct, an inability of the items to discriminate between the two, or simply a reflection of the airline’s size and organizational structure. Further testing with a larger sample in a larger organization is necessary to fully address this question.

This survey did suggest a change in focus for one dimension. We changed the Reward dimension, originally conceptualized to focus on the consequences and contingencies surrounding safe and unsafe behavior, to Accountability. Several respondents made comments suggesting that the focus on reward may have been inappropriate, or that a slightly different approach to the topic would be more informative. They indicated that concerns about safety culture were not due to a lack of consequences for unsafe behavior, but a lack of consistency with which the consequences were applied. Respondents mentioned situations in which unsafe acts were viewed differently depending on the situation (i.e., cost-saving or not) or the pilot involved. Items involving positive consequences for safe behavior generally performed poorly, perhaps because participants considered them redundant. Many comments suggested that safe behavior is an integral component of a pilot's job, not above-and-beyond behavior that should be specially rewarded. It seems more appropriate, then, to look at the organizational contingency system in terms of accountability and consistency rather than reward and recognition. The scale has been renamed and refined in these terms. Therefore, we have redefined the organizational indicator of Reward Systems to reflect standards of Accountability, changing the five organizational indicators of safety culture to:

- Organizational Commitment
- Management Involvement
- Employee Empowerment
- Accountability
- Reporting Systems

Finally, several pilots did comment on the perceived risk items, indicating that they were uncomfortable making forecasts about a phenomenon they perceived as complex and difficult to predict. This concern suggests that future measures of risk perception may benefit from a different structure or approach. Assessing *relative* risk, as in “this airline is more likely to be involved in an accident than the average airline,” may be a solution, as it acknowledges a baseline element of risk and does not require the respondent to make an absolute judgment.

Conclusions

The objectives of the present study were twofold: (1) to assess the current state of safety culture among pilots at the airline, and (2) to provide an initial practical and empirical test of the items in the Commercial Aviation Safety Survey, to facilitate development of a measure of safety culture applicable to a variety of airlines and other organizations. Both objectives were largely accomplished, though certain limitations of the research do exist. In all, however, the data suggest valuable insights into both the safety culture of one organization and the problem of assessing safety culture in general.

Safety Culture at the Airline

Survey results indicated that the overall safety culture at the airline is generally positive on all five dimensions, though considerable variance exists in pilots' safety culture perceptions and all areas show room for improvement. The safety culture at the airline appears to be strongest in the areas of Organizational Commitment and Employee Empowerment and weakest in the area of Reward Systems. Particular strengths included formal documentation (such as manuals, checklists, and the official safety reporting system), emphasis on safety in training, and visible management concern for safety. Inconsistently applied consequences for unsafe behavior and a discrepancy between peer and organizational consequences were identified as challenge areas. Respondent comments also suggest several specific points in which safety culture could be improved. This feedback can aid management at the airline in effectively allocating resources to these safety issues.

The generality of these findings are somewhat limited by the size and nature of the sample. Only pilots and supervisory personnel were asked to complete the survey, so no conclusions can be reached regarding the state of safety culture among maintenance personnel, administrative staff, or other groups of employees. In addition, the response rate was moderately low, with only 40% of pilots and supervisors returning surveys. Several factors, including the length of the survey (86 items) and the fact that respondents were asked to complete it on non-company time, may have discouraged employees from responding. This raises the question of whether the respondents constitute an appropriately representative sample of pilots and managers at the airline. Bias often occurs in voluntary survey research when groups of individuals who differ in some fashion relevant to the survey respond at different rates – for example, pilots with negative views of the safety culture at the airline may have been more motivated to respond to a safety survey than pilots who are content. While it is not possible to definitively determine whether bias was present without surveying non-respondents, it does not appear that bias was evident to any significant degree in the present study. Scale scores for all five dimensions varied across a broad range (including both positive and negative scores) and did not deviate appreciably from a normal distribution. It seems reasonable to conclude that the survey respondents represent the overall spectrum of attitudes towards safety culture at the airline.

The Safety Culture Grid

Once the organizational scales were identified, the question arose, so what does this mean? How can this data be related back to the airline in a meaningful way that demonstrates the interrelationships between all of the organizational factors? What configuration can be used to show the features of each organization's unique safety culture? Safety culture may be best approximated on a multidimensional continuum or grid, as it appears to fall outside the realm of a pyramid or linear configuration (Blake & Mouton, 1964). Rather, it exists within a continuum

of related variables, factored in concert with managerial and employee perceptions that reveal the true structure of the organizational safety culture as it exists at the time of assessment (Figure 3).

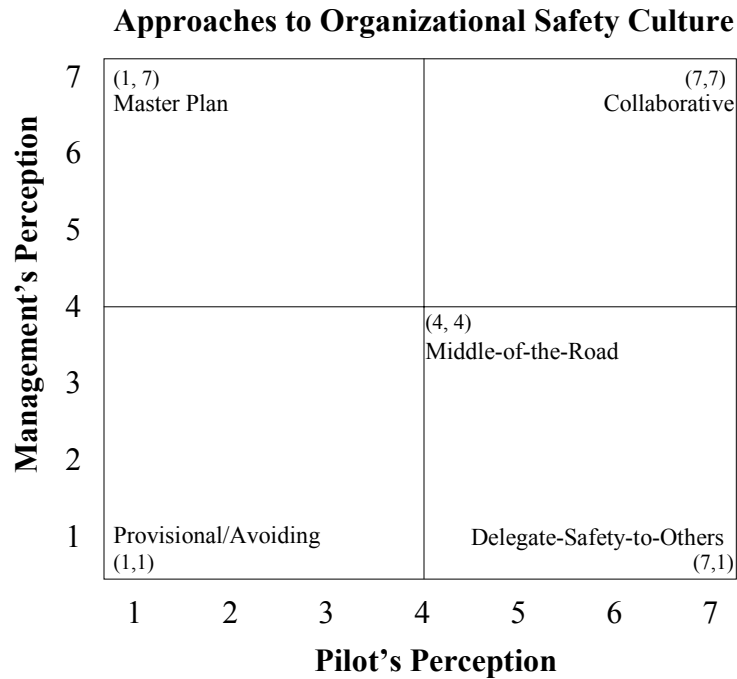


Figure 3. The Safety Culture Grid.

Five general types of organizations can be identified by plotting management's and pilot's perceptions of safety culture. These organizational types represent a fusion of strategic management science and organizational behavior principles (Brodwin & Bourgeois, 1984; Thompson & Strickland, 1993) and are described below:

(7, 7) Collaborative

In a Collaborative safety culture, safety is seen as a primary concern. Management enlists the help of key employees in developing a consensus plan for safety that all employees will endorse and do their best to implement successfully. Organizational leadership encourages employees to share in decision-making and problem solving, and keeps employees informed about matters that affect them. Everyone in the company shares in the implementation of the safety plan (shared vision). Leaders are visible and approachable. Employees have ownership in the plan and a stake in proactively committing to its successful execution. Since employees have ownership, they can also be held accountable for assuring safety works and are empowered to evaluate their own performance. This may have a downside however, in that an organization may not be able to afford mistakes that come from recognizing/facilitating every social claim as legitimate. Employees may not have the expertise possessed by management in recognizing certain safety factors. Key factors are:

- High assertiveness and high cooperation
- Employees responsible to evaluate their own performance
- Employee/management established goals
- Recognizes and encourages personal responsibility for safety
- Esprit de corps
- Always seeking to improve
- Looking for ways to develop a win-win situation

(1, 7) *Master Plan*

Where there exists a Master Plan for safety, the manager functions as chief, exercising strong influence over the details and alternatives in the organization's safety strategy; a by-the-book type of leadership committed to enforcing rules and auditing behavior is employed. The manager acts as guiding leader and has a big ownership stake in the chosen safety plan (achievement oriented). Management is calculative, having a rule or system in place to manage threats (hazards) and does not consult employees about their safety concerns. This approach can be effective in areas where employees have little insight into the global aspects of the operation. Employees here need to operate by-the-book with regard to standards and procedures, such as handling delicate or dangerous equipment or performing tasks over and over again. This may be ineffective when flexible decision-making is needed to break routines that are no longer useful; resulting in employees doing only what is expected of them and nothing more. Key factors are:

- High managerial assertiveness
- Means of ensuring safety performance, by-the-numbers
- Conservative decision-making
- Operates by detailed procedures/instructions/measures
- Work carried out according to procedure or policy
- Safety-by-the-Rules

(7, 1) *Delegate-Safety-to-Others*

In this safety culture, management delegates the development of safety strategy to employees, such as a strategic planning staff or task force of trusted employees, giving them as much freedom as possible. The culture is based on employee personal experience, judgment, and effort rather than technological aids or formal plans (a seat-of-the-pants approach). Authority is given to the employees to determine their safety goals, make decisions and resolve problems on their own. Management stays distant, keeping in touch via reports or conversations, offering guidance if needed, reacting to informal "trial" recommendations, and perhaps approving a plan after it has been formally presented, discussed, and a consensus emerges from the employees (laissez faire or hands off). Management rarely has much ownership in the recommendations and

privately may not see much urgency to implement some or much of what has been written in the company's official plan. Often the safety strategy is temporary and reactive; it deals more with today's problems than with instilling the organization with enduring safety values. This style may prove effective in a company where the employees are highly skilled, educated and motivated. Some employees, however, may feel insecure at the lack of supervisory availability, and managers may not be able to provide feedback to employees regarding their safety performance, or be able to thank employees for a job well done. This hands-off approach may also conceal bad management. Key factors are:

- High employee assertiveness
- Employees entrusted with setting safety standards
- Employees have pride in company safety record
- Staff specialists utilized
- Works well with highly skilled, educated, and experienced employees
- Based on personal experience
- Laissez faire management

(1,1) *Provisional/ Avoiding*

In a Provisional or Avoiding safety culture, management expects employees to implement safety strategies. The Manager is neither interested in crafting the details of safety policy nor in the time-consuming task of reaching consensus with employees. Management does not consult employees, nor do employees give input. When needed, management "tells" employees how safety should be managed, but largely it remains undefined. Safety is viewed within the confines of the immediate task at hand, without consideration for the organization as a whole. Accidents and incidents are seen as part of the job, with temporary or reactive fixes resulting. Employees are expected to follow safety policies without explanation, and stay motivated through a structured set of rewards and punishments. This safety culture may prove effective with employees who may have high volume production schedules on a daily basis or there is limited time for decision-making. This may prove ineffective with employees who expect their managers to make their decisions, or need their work coordinated with other departments or organizations. There is low organizational commitment with highly centralized management. Safety may be carried out through existing policy whether it works or not. Key factors are:

- Avoidance: low assertiveness, low cooperation
- Do-it-yourself
- Ad-hoc
- Unplanned
- Vague

(4,4) *Middle-of-the-Road*

The goal in a Middle-of-the-Road safety culture may be to find a central ground or to be yielding. It may indicate the lack of bold, thoughtful initiative. This may also represent political consensus with the outcome shaped by influential subordinates, powerful departments, or majority coalition that have a strong stake in promoting their own version of what the safety policy ought to be. Politics and power plays may be strongly indicated in an environment where there is no consensus on what strategy to adopt. Key factors are:

- Compromising: moderate assertiveness, moderate cooperation
- Accommodating: low assertiveness, high cooperation

Using the mean values scored from the CASS, we were able to plot the airline’s safety culture factor into the grid (Figure 4), demonstrating an organization that values a collaborative, team environment.

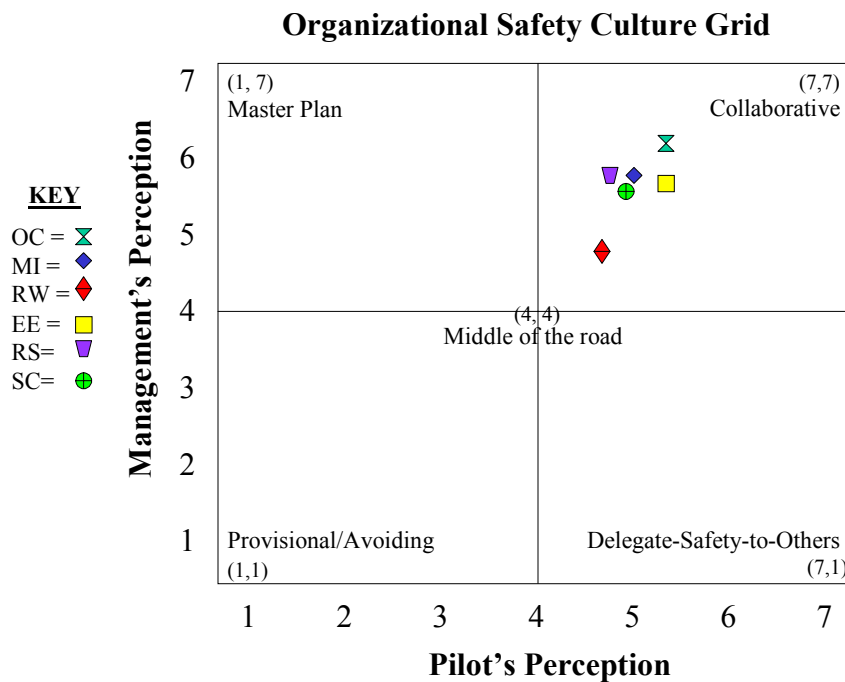


Figure 4. Safety Culture as it is plotted at the airline studied.
OC=Organizational Commitment, MI=Management Involvement, RW=Reward System, EE=Employee Empowerment, RS=Reporting System, SC=Total Safety Culture Score

Grid placement of the scores obtained from the airline used in this study indicates that the airline generally espouses a collaborative environment. However, as can be seen from the grid, management must target issues regarding *reward systems* if they are to improve or enhance their collaborative approach to safety. As an example, some comments in the survey pertained to

“favored sons” or that a few pilots received favoritism from management when it came to enforcing the rules. Some respondents thought that management “looked the other way” or failed to address safety problems associated with certain pilots. However, management in this case viewed themselves as fair and were willing to take extra steps to aid in the retraining/rehabilitation of pilots who make mistakes (though not willful disregard of the law), in some cases granting leave while an issue is resolved. Yet some line pilots perceived this treatment as preferential. This has opened management’s eyes to the fact that what they perceive as humane treatment, other employees may view as favoritism, and as such negatively affects the safety culture. Steps to remedy this situation, via published procedures and open communication about management policies have been initiated by the airline.

Still, there is no one degree of safety culture to satisfy all organizational needs or all organizations. However, the grid approach allows an organization to assess its own safety culture in relationship to its own mission and values, and according to the type of work performed. To fall at one extreme or another on the safety culture grid is indicative of the values placed on worker safety and protocols. This grid configuration allows an organization to strategically chart where it stands, and understand the principles behind its mission in relation to its safety culture. The outcome may be that an organization is satisfied with its placement on the safety culture grid, as it exists, and may wish to retain the status quo. An organization can also begin to move toward a safety culture that reflects the best fit for the purposes of the type of work and workers in the organization, by shifting the focus of the underlying cultural factors towards the type of culture it would most like to represent.

Future Research

Though the present research is only one step in the development of a measure of airline safety culture, it provides considerable insight into what future steps might entail. The most pressing need is for replication in a sample large enough to permit factor analytical techniques to be utilized. The airline example suggests that the nature of the dimensions may vary according to the size and structure of the organization; that is, larger organizations may require more or different dimensions than smaller ones. Testing across a wider sample of airlines is also necessary to establish predictive validity: whether differences in safety culture scores predict differences in risk perceptions or actual accident/incident rates. The present survey is targeted exclusively toward pilots, but pilots are not the only airline employees responsible for safety in aviation. A corresponding survey for maintenance personnel is currently under development. Additional plans include the development of a secure Internet version of the survey to facilitate administration for large or geographically distributed groups of respondents. The ultimate goal of the project is to develop an instrument or set of instruments that can be made available to a variety of airlines or regulatory agencies in order to assess the strengths and weaknesses of a particular safety culture.

Acknowledgment

This research was supported in part by the Federal Aviation Administration, FAA Grant 01-G-015. Kathy Fazen was the technical monitor.

References

- Anderson, N. & West, M. (1996). The team climate inventory: Development of the TCI and its applications in teambuilding for innovativeness. *European Journal of Work & Organizational Psychology*, 5(1), 53-66.
- Bailey, L.L., Peterson, L.M., Williams, K.W. & Thompson, R.C. (2000). *Controlled flight into terrain: A study of pilot perspectives in Alaska* DOT/FAA/AAM-00/28. Office of Aviation Medicine, Washington, DC.
- Blake, R. R. & Mouton, J. S. (1964). *The managerial grid, key orientations for achieving production through people*. Houston, TX: Gulf Pub. Co.
- Brodwin, D. R., & Bourgeois, L. J. (1984). Five steps to strategic management. In G. Carroll & D. Vogel (Eds.), *Strategy and organization: A west coast perspective* (pp. 168-178). Marshfield, MA: Pittman Publishing.
- Bureau of Air Safety Investigation (1996). Proactively monitoring airline safety performance. *Air Safety Report*. Author: Melbourne, Australia.
- Ciavarelli, A., Jr. & Figlock, R. (1996). Organizational factors in aviation accidents. *Proceedings of the Ninth International Symposium on Aviation Psychology*. (pp. 1033 – 1035). Columbus, OH: Department of Aviation.
- Cox, S. & Cox, T. (1991). The structure of employee attitudes to safety: A European example. *Work & Stress*, 5, 93-104.
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3), 297-334.
- Dastmalchian, A., Blyton, P., & Adamson, R. (1989). Industrial relations climate: Testing a construct. *Journal of Occupational Psychology*, 62(1), 21-32.
- Dedobbeleer, N., & Beland, F. (1991). A safety climate measure for construction sites. *Journal of Safety Research*, 22, 97-103.
- Desatnick, R. L. (1986). Management climate surveys: A way to uncover an organization's culture. *Personnel* 63(5), 49-55.

- Dorn, L., & Matthews, G. (1995). Prediction of mood and risk appraisals from trait measures: Two studies of simulated driving. *European Journal of Personality*, 9, 25-42.
- Eiff, G. (1999). Organizational safety culture. *Proceedings of the 10th International Symposium on Aviation Psychology* (pp. 1-14). Columbus, OH: Department of Aviation.
- Fleming, M. T., Flin, R., Mearns, K., & Gordon, R. (1996). The offshore supervisor's role in safety management: Law enforcer or risk manager. *Paper presented at the Third International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production*. New Orleans, LA.
- Flin, R., Mearns, K., O'Connor, P., & Bryden, R. (2000). Measuring safety climate: Identifying the common features. *Safety Science*, 34, 177-192.
- Frikken, A.J. (1997). A survey to assess regulatory influence on safety culture at the HIFAR reactor. Nuclear Safety Bureau: Miranda, NSW, Australia.
- Geller, E. S. (1994). Ten principles for achieving a total safety culture. *Professional Safety*, 39(9),18-24.
- Gordon, R., Flin, R., Mearns, K., & Fleming, M. T. (1996). Assessing the human factors causes of accidents in the offshore oil industry. *Paper presented at the Third International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production*. New Orleans, LA.
- Janssens, M., Brett, J., & Smith, F. (1995). Confirmatory cross-cultural research: testing the viability of a corporation-wide safety policy. *Academy of Management Journal*, 38(2), 364-382.
- John, O. P., & Benet-Martinez, V. (2000). Measurement: reliability, construct validation, and scale construction. In H. T. Reis & C. M. Judd (Eds.), *Handbook of research methods in social and personality psychology*. New York: Cambridge University Press.
- Kivimaki, M., Kuk, G., Elovainio, M., Thomson, L., Kalliomaki-Levanto, T., & Heikkila, A. (1997). The team climate inventory (TCI) – four or five factors? *Journal of Occupational & Organizational Psychology*, 70(4), 375-389.
- McDonald, R. P. (1999). *Test theory: A unified treatment*. Mahwah, NJ: Lawrence Erlbaum.
- Meshkati, N. (1997, April). *Human performance, organizational factors and safety culture*. Paper presented on National Summit by NTSB on transportation safety. Washington, DC.

- Mueller, L., DaSilva, N., Townsend, J., & Tetrick, L. (1999). An empirical evaluation of competing safety climate measurement models. *Annual meeting of the Society for Industrial and Organizational Psychology*. Atlanta, GA.
- NASA Non Supervisory Employee Safety Performance Survey (1998) Developed for the U. S. Government under contract NAS9-19181. Hernandez Engineering, Inc.
 wysiwyg://34/http://pep.jsc.nasa.gov/m49mfdlGSFC/empGSFC.htm
- Nunnally, J. C. (1967). *Psychometric theory*. New York: McGraw-Hill.
- Ostrom, L. C., Wilhelmsen, C. & Kaplan. B.L. (1993). Assessing safety culture. *Nuclear Safety*, 34(2), 163-172.
- Pidgeon, N. (1998). Safety culture: Key theoretical issues. *Work & Stress*, 12(3), 202-216.
- Pizzi, L.T., Goldfarb, N.I., & Nash, D.B. (2001). Promoting a culture of safety. Chapter 40 in Shojania, K.G., Duncan, B.W., & McDonald, D.M. editors. *Making health care safer: a critical analysis of patient safety practices. Evidence Report/Technology Assessment Number 43* (prepared by the University of California at San Francisco-Stanford Evidenced-based Practice Center under Contract no. 290-97-0013), AHRQ Publication No. 01-E058, Rockville Maryland: Agency for Healthcare Research and Quality/
- Rakovan, L., Wiggins, M., & Jensen, R., & Hunter, D.R (1999). *A national pilot survey to enhance the development and dissemination of safety information*. Washington, DC: Federal Aviation Administration (NTIS DOT/FAA/AM-99/7).
- Reason, J. (1990). *Human error*. New York, NY: Cambridge University Press.
- Rybowiak, V., Garst, H., Frese, M. & Batinic, B. (1999). Error orientation questionnaire (EOQ): Reliability, validity, and different language equivalence. *Journal of Organizational Behaviour*, 20, 527-547.
- Schriber, L. B., & Gutek, B.A. (1987). Some time dimensions of work: measurement of an underlying aspect of organization culture. *Journal of Applied Psychology*, 72(4) 642-650.
- Thompson, A.A., Jr., & Strickland, A.J. (1993). *Strategic management: Concepts and cases*, Boston, MA: Irwin.
- Wiegmann, D. A., Zhang, H., & von Thaden, T. L. (2001). Defining and assessing safety culture in high reliability systems: An annotated bibliography. (ARL-01-12/FAA-01-4). Savoy, IL: University of Illinois, Aviation Research Lab.

- Wiegmann, D. A., Zhang, H., von Thaden, T., Sharma, G., & Mitchell, A. (2002). *A synthesis of safety culture and safety climate research* (ARL-02-3/FAA-02-2). Savoy, IL: University of Illinois, Aviation Research Lab.
- Yule, S. J., Flin, R., & Murdy, A. J. (2001, April 27-29). Modeling managerial influence on safety climate. *Poster presented at Society for Industrial and Organizational Psychology (SIOP) Conference*. San Diego, CA.
- Zhang, H., Wiegmann, D. A., von Thaden, T., Sharma, G., & Mitchell, A. (2002). Safety culture: A concept in chaos? *Proceedings of the 46th Annual Meeting of the Human Factors and Ergonomics Society*. Santa Monica, CA: HFES.
- Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. *Journal of Applied Psychology*, 65, 96-102.
- Zohar, D. (2000). A group-level model of safety climate: Testing the effect of group climate on micro-accidents in manufacturing jobs. *Journal of Applied Psychology*, 85, 587-596.

Appendix A: Questionnaire Items Used in CASS Development

Bailey, Peterson, Williams, & Thompson (2000) Pilot Perceptions of Flying Conditions (in Alaska)

Alaskan Pilot and FAA Official Interaction (8 items)

1. In Alaska, FAA inspectors adequately explain the rationale behind the decisions they make.
2. When interacting with FAA inspectors, Alaskan passenger and freight pilots are allowed to express their point of view.
3. FAA inspectors use the same evaluation standard for Alaskan passenger and freight pilots.
4. FAA inspectors are courteous when interacting with Alaskan passenger and freight pilots.
5. Overall, the FAA inspectors treat Alaskan passenger and freight pilots fairly.
6. If Alaskan passenger and freight pilots followed all aspects of the FARs, they would not be able to get their job done.
7. Additional exemptions are needed in the FARs so that the rules conform to the reality of Alaskan flight operations.
8. The FARs interfere with the profitability of Alaskan passenger and freight operations.

Organizational Influences - Organizational Climate

1. In Alaska, if one passenger or freight company does not fly because of weather, there is a chance that the company next door will go ahead and fly.
2. My company stays in touch with pilot concerns and problems.
3. My company does not cut corners where safety is concerned.
4. My company does all that it can to prevent accidents.
5. My company is more concerned about making money than being safe.
6. In my company getting the job done has higher priority than safety.
7. In my company pilot morale is high.

8. My company appreciates the good work that I do.
9. My company considers the safety of its pilots as its top priority.
10. In Alaska, passenger and freight companies rarely question a pilot's decision to turn around due to weather.
11. Passenger and freight pilots in Alaska are encouraged to turn around when the weather deteriorates en route.
12. Rank the following according to who has the greatest responsibility for pre-departure weather conditions:
 - a. Pilot
 - b. Flight follower or dispatcher
 - c. Company management (i.e., Director of Operations or Chief Pilot)
 - d. Other
13. Who makes the final pre-departure go-no-go decision?
14. I am satisfied with the way my company deals with pilot complaints.

Organizational Influences - Organizational Process (16 items)

1. Passenger and freight companies in Alaska operate on small profit margins.
2. My company's safety practices are: ("at bottom of industry", "below average", "average", "above average", "at top of industry")
3. The majority of my flights are flown over the following terrain: (checklist)
4. In my company, awards are used to promote safe flying.
5. Indicate the method used to determine your pay: ("Base salary", "By flight hrs", "By difficulty of assignment", "Other")

6. My company's safety program includes something like a risk management or internal audit process.
7. My company conducts formal pilot safety meetings.
8. My company provides me with opportunities to make safety recommendations.
9. My company's safety meetings focus on hard-hitting safety issues that pilots face each day.
10. My company's safety program includes something like a safety risk reporting form.
11. My company launches weather reporting observation flights to supplement pre-departure weather services.
12. Pilot training on how to operate in low visibility conditions is provided by my company.
13. My company uses each of the following weather reporting services during pre-departure weather evaluations: (checklist).
14. My company's training program contains an inadvertent IMC recovery procedure.
15. My company requires "re-dispatch" or "re-contact" with the company when pilots reroute due to weather.
16. Alaskan passenger and freight companies formally teach unwritten "rules of thumb" for flying in areas of low ceiling and reduced visibility.

Organizational Influences - Resource Management (6 items)

1. The average age of the aircraft my company uses is ___ years old.
2. What kind of navigational equipment do you use when flying VMC through low visibility? (checklist)
3. In the last two years, I have received training on weather and weather avoidance approximately: ("0 to 1 times", "2 to 4 times" "5 to 8 times", "More than 8 times", "Other")

4. Rank the following methods according to how effective each is in obtaining qualified pilots for your company:
 - a. Reviewing pilot's past accident records.
 - b. Conducting check rides.
 - c. Conducting face-to-face interviews.
 - d. Getting recommendations from other pilots.
 - e. Conducting pre-employment background checks.
5. Passenger and freight pilots can find work flying in Alaska even if they have prior aviation accidents on their record.
6. My company provides sufficient maintenance on each of the following aircraft components: (checklist)

Preconditions for Unsafe Acts - Substandard Conditions (17 items)

1. As a pilot I am concerned about having an accident while flying.
2. Passenger and freight pilots in Alaska would feel comfortable flying VMC in low visibility over hills and mountains.
3. In Alaska, safety would improve if the visibility requirement for special VFR (conducted under FAR Part 135) was increased to 2 miles when operating under a ceiling of less than 1000 feet.
4. In Alaska, passenger and freight pilots would feel comfortable flying VMC in low visibility over flat terrain or water.
5. Alaskan passenger and freight pilots talk about having to "push" the weather during their flights.
6. In Alaska, one seldom sees passenger and freight pilots "push" the weather at community airports.
7. Compared to other Alaskan pilots with similar flying experience, the salary that I receive is: ("below the industry average", "at the industry average", "above the industry average").
8. In Alaska, during periods of extended daylight, pilot and co-pilot aircrews fly over 10 hours per day.

9. Alaskan passenger and freight pilots understand how the time of day can affect their flying performance.
10. It is hard for Alaskan passenger and freight pilots to maintain a consistent sleep schedule.
11. In Alaska, during periods of extended daylight, a single-pilot aircraft flies over 8 hours per day.
12. Over time, being an Alaskan pilot will adversely affect my health.
13. As an Alaskan pilot, the job that I perform requires flying in hazardous conditions.
14. Alaskan passenger and freight pilots have to fly sometimes when they are tired.
15. Alaskan passenger and freight pilots have to fly even when ill.
16. Boredom is a problem for Alaskan passenger and freight pilots.
17. Unless Alaskan passenger and freight pilots stay on top of the situation, they can soon become overwhelmed with sudden changes in flying conditions.

Preconditions for Unsafe Acts - Substandard Practices of Operators (13 items)

1. Rank the following factors based on the amount of pressure created by each to fly in reduced visibility:
 - a. Making money for myself.
 - b. Passengers.
 - c. Pride in my ability.
 - d. Tight schedule.
 - e. Company management.
 - f. Delivering the U.S. mail.
 - g. Peer pressure.
 - h. Other reasons for flying in reduced visibility.
2. My total number of commercial A/C hours flown in Alaska is ___ commercial fixed wing hours.
3. I've flown in Alaska a total of ___ years (round to the nearest year)
4. I attend pilot safety meetings of some kind.
5. My total number of commercial A/C hours flown in Alaska is ___ commercial rotary hours.
6. In Alaska, it is possible to eliminate all accidents caused by passenger and freight pilots flying into terrain in poor weather.
7. My total number of non commercial A/C hours flown in Alaska is ___ non commercial rotary hours.
8. My total number of non commercial A/C hours flown in Alaska is ___ non commercial fixed wing hours.
9. I fly in Alaska during the following months.
10. I hold the following airman's certificates and ratings:
11. Please indicate the certificate holders you work for.
12. I am ___ years old.
13. My permanent residence is in Alaska.

Unsafe Acts (9 items)

1. Flying under VFR in low visibility conditions over hills and mountains is a common experience for Alaskan passenger and freight pilots.
2. In Alaska, "rules of thumb" learned from more experienced passenger and freight pilots are required in order to fly through areas of low clouds and reduced visibility.
3. It is safe for Alaskan passenger and freight pilots to fly under low-lying narrow bands of clouds, provided that the visibility is clear beneath the clouds and it looks clear beyond the cloudy area.
4. Passenger and freight pilots in Alaska are more likely to "push" the weather when aircraft are equipped with more modern navigation equipment.
5. For Alaskan passenger and freight operations, it is considered safe to fly VMC in visibility below 1 mile on routes over which the pilot has flown many times before.
6. When flying VMC over flat terrain, I would turn around when the visibility is reduced to: (5 miles, 2 miles, 1 mile, 1/2 mile or less, unable to see landmarks)

7. When flying VMC over mountains, I would turn around when the visibility is reduced to: (5 miles, 2 miles, 1 mile, 1/2 mile or less, unable to see landmarks)
8. In Alaska, it is safe for passenger and freight pilots to fly VMC en route when visibility is less than 1 mile, provided that pilots know the destination weather is good.
9. It is OK for Alaskan passenger and freight pilots to fly in weather below 500-foot ceilings and 1-mile visibility as long as the pilot feels it can be done safely.
2. My company ensures that pilots obtain sufficient training on new equipment.
3. In Alaska, passenger and freight assignments require flying under marginal VMC.
4. My company's Standard Operating Procedures manual is up to date.
5. Before each flight, my company makes sure pilots are physically fit to fly (e.g., free from the adverse effects of fatigue, medications).
6. Before each flight, my company makes sure that pilots have the right frame of mind for flying.

Unsafe Supervision (6 items)

1. The first time my company discovered I flew through weather below legal VFR, they would: ("do nothing", "give me a warning", "place me on suspension", "fire me")

Note: Various response formats. Many levels of categorization – some subdimensions have been collapsed for simplicity.

Bureau of Air Safety Investigation (1996)
Safety Culture and Hazard Risk Perception

1. What is your usual position? (e.g., Captain, FO, FA, LAME)
2. What is your age?
3. What is your gender?
4. How long have you worked at XYZ airlines?
5. Employees are given enough training to do their work tasks safely.
6. Managers get personally involved in safety activities.
7. In my work area, there are procedures to follow in the event of an emergency.
8. Managers often discuss safety issues with employees.
9. Employees do all they can to prevent accidents.
10. Everyone is given sufficient opportunities to make suggestions regarding safety issues.
11. Employees often encourage one another to work safely.
12. Managers are aware of the main safety problems in the workplace.
13. All new employees are provided with sufficient safety training before commencing their work.
14. Managers often praise employees they see working safely.
15. Everyone is kept informed of any changes which may affect safety.
16. Employees follow safety rules almost all of the time.
17. Safety here is better than other airlines.
18. Managers do all they can to prevent accidents here.
19. Accident investigations attempt to find the real causes of accidents, rather than just blame the people involved.
20. Managers fail to recognize when employees are working unsafely.
21. Any faults or hazards that are reported get rectified promptly.
22. In my work area, there are mechanisms in place for me to report safety deficiencies.
23. Managers stop unsafe operations or activities.
24. After an accident has occurred, appropriate actions are usually taken to reduce the chances that a similar event will occur in the future.
25. Everyone is given sufficient feedback regarding company safety performance.
26. Managers regard safety to be a very important part of all work activities.
27. Safety audits are carried out frequently.
28. Safety within this company is generally well controlled.
29. Employees usually report any dangerous work practices they notice.
30. Do you have any additional comments to make regarding safety at XYZ Airlines?
31. Rate each hazard according to their potential to affect the safety of fare paying passengers: Poor equipment design.
32. Rate each hazard according to their potential to affect the safety of fare paying passengers: Failure to correctly follow procedures.
33. Rate each hazard according to their potential to affect the safety of fare paying passengers: Aircraft turbulence.
34. Rate each hazard according to their potential to affect the safety of fare paying passengers: Failure to follow a schedule aircraft maintenance check.
35. Rate each hazard according to their potential to affect the safety of fare paying passengers: Inadequate manuals.
36. Rate each hazard according to their potential to affect the safety of fare paying passengers: Landing gear failure.

37. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Aircraft icing.
38. Rate each hazard according to their potential to affect the safety of fare paying passengers: Poor flight crew judgment.
39. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Incorrect operation of equipment.
40. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Handling aircraft outside published standards.
41. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Thunderstorm.
42. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Improper staff supervision.
43. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Regulations open to interpretation.
44. Rate each hazard according to their potential to affect the safety of fare paying passengers: Poor ATS procedures.
45. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Inadequate training.
46. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Failure to correctly inspect airframe.
47. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Windshear (large changes in wind speed and/or direction which alter aircraft performance).
48. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Failure to regularly inspect airport ground facilities.
49. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Incorrect aircraft loading.
50. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Failure to correctly maintain aircraft fuel system.
51. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Failure to maintain flight control systems.
52. Rate each hazard according to their potential to affect the safety of fare paying passengers:
Failure to maintain aircraft powerplant.

Note: No subdimensions. Not in the original format. Response format: Item 5-29: 5-point Likert (1=strongly agree, 5=strongly disagree); Item 31-52: 9-point Likert for hazardousness (0=not at all hazardous, 8=extremely hazardous), and 9-point Likert for likelihood (0=not at all, 8=extremely likely).

Ciavarelli & Figlock (1996) Command Safety Assessment

Process Auditing

1. My command conducts adequate reviews and updates of safety practices.
2. My command has a defined process to set training goals and to review performance.
3. My command closely monitors proficiency and currency standards to ensure aircrew are qualified to fly their assigned missions.
4. My command provides adequate safety backups to catch possible human errors during high-risk missions.
5. Procedures in my command are adequate to effectively conduct Human Factors Councils or Boards.
6. Human Factors Councils have been successful in identifying aircrew members who pose a risk to safety.
7. Human Factors Boards have been successful in managing the high-risk aviator.
8. My command makes effective use of the flight surgeon to help identify and manage high-risk personnel.

Reward System

1. Command leadership encourages reporting safety discrepancies without the fear of negative repercussions.
2. Individuals in my command are willing to report information regarding safety violations, marginal aviator performance, or other unsafe behavior.
3. In my command, peer influence is effective at discouraging violations of operating procedures, flying regulations, or general air discipline.
4. In my command, anyone who intentionally violates NATOPS/SOP is swiftly corrected.
5. In my command, violations of operating procedures, flying regulations, or general flight discipline are rare.

6. My command recognizes an individual's safety achievement through rewards and incentives.

Quality

1. My command has a reputation for high-quality performance.
2. My command has established quality standards and strives to maintain quality control.

Risk Management

1. Command leadership permits "cutting corners" to get the job done.
2. Loss of experienced personnel has negatively affected my command's ability to operate safely.
3. Safety decisions are made at the proper levels by the most qualified people in my command.
4. Command leadership considers safety issues during the formation and execution of operational and training plans.
5. Command leadership has a clear picture of the risks associated with its flight operations.
6. My command takes the time to identify and assess risks associated with its flight operations.
7. My command does a good job managing risks associated with its flight operations.
8. My command has increased the chances of a mishap due to inadequate or incorrect risk assessment.
9. I am provided adequate resources (time, staffing, budget, and equipment) to accomplish my job.
10. My command provides the right number of hours per month for me to fly safely.
11. My non-flying duties adversely affect my ability to accomplish my flying mission safely.
12. I have adequate time to prepare for and debrief my flights.
13. Based upon my command's personnel and other assets, the command is over-committed.

14. My command has received adequate guidance, information, and training regarding Operational Risk Management.
15. My command has begun to implement Operational Risk Management processes into decision making at all levels.

Command and Control

1. My command is genuinely concerned about safety.
2. Command leadership is successful in communicating its safety goals to unit personnel.
3. My command provides a positive command climate that promotes safe flight operations.
4. Command leadership is actively involved in the safety program and management of safety matters.
5. Command leadership sets the example for compliance with flight standards.
6. My command ensures that all unit members are responsible and accountable for safe flight operations.
7. Command leadership willingly assists in providing advice concerning safety matters.
8. Command leadership reacts well to unexpected changes to its plans.
9. In my command, we believe safety is an integral part of all flight operations.
10. My command does not hesitate to temporarily restrict from flying individuals who are under high personal stress.
11. I am adequately trained to safely conduct all of my flight missions.
12. Morale and motivation in my command are high.

13. My command ensures the uniform enforcement of operating standards among unit members.
14. Command leadership is effective at discouraging violations of operating procedures, flying regulations, or general air discipline.
15. My command's Operations SOP is effective at promoting safe flight operations.
16. I am very familiar with the policies and regulations contained in OPNAVINST 3710.
17. Crew rest standards are enforced in my command.
18. In my command, NATOPS tests and check rides are conducted as intended, to candidly assess aircrew qualifications.
19. Strict enforcement of NATOPS standards is upheld in my command.
20. Within my command, good communications flow exists up and down the chain of command.
21. My command has good two-way communication with external commands.
22. Safety education and training are adequate in my department.
23. The Safety Department is a well respected element of my command.
24. The Aviation Safety Officer position is a sought after billet in my command.
25. My command's Safety Department keeps me well informed regarding important safety information.
26. My command's Aircrew Coordination Training program is helping to improve mission performance and safety.

Note: Response format: 7-point Likert (1=strongly disagree, 2=moderately disagree, 3=disagree, 4=neutral, 5=agree, 6=moderately agree, 7=strongly agree).

Cox & Cox (1991)
Attitudes to Safety

Personal Skepticism

1. Safety works until we are busy.
2. If I worried about safety I would not get my job done.
3. There is no point in reporting a near-miss.
4. Not all accidents are preventable.
5. Safety equipment requirements are unrealistic.

Individual Responsibility

1. Safety equipment should always be worn.
2. Individual should encourage colleagues to work safely.
3. Individual shares responsibility for safety

Safeness of Work Environment

1. Less chance of having an accident at work than when working at home.
2. The company is a safer place to work than other companies.

3. People with minor injuries that have been treated should be asked to come to work.

4. Depot Safety Committee is effective.

Effectiveness of Arrangements for Safety

1. Safety equipment should always be worn.
2. Company should be as concerned for safety as for profits.
3. Safety audits are a valuable exercise.
4. People understand company's operating procedures
5. Depot Safety Committee is effective.

Personal Immunity

1. People who work to procedures will always be safe.
2. Accidents only happen to other people.

Note: The dimensions come from factor analysis, and highlighted items have high loadings on more than one dimension. Response format: 5-point Likert (1=strongly disagree, 2=disagree, 3=no opinion, 4=agree, 5=strongly agree, with an additional option "I do not understand this statement").

Janssens, Brett, & Smith (1995)
Perceptions of Safety Level

Management's Overall Concern

1. I am satisfied with the way the organization deals with employee complaints.
2. It seems to me, top management of the company is in touch with the concerns and problems of the people at my level in the organization.
3. At this time, how would you rate the morale of employees you work with?
4. When things go well in your job, is your contribution recognized?

Production as a Priority

1. Supervisors seem more concerned about their production performance than safety performance.
2. Management here definitely puts production, cost, and quality ahead of safety.

Safety as a Priority

1. Management clearly considers the safety of employees most important here.
2. Management here does not cut corners where safety is concerned.
3. The equipment used here is good and well taken care of.
4. Management here does all it can to prevent accidents.

Perceived Safety Level

1. I am often worried about being injured on the job.
2. In my opinion, my work environment has or will have a serious effect on my health.
3. How do you feel about your overall work environment?

Note: Response format: 5-point Likert (1=strongly disagree, 5=strongly agree) for all items except item 3 in "perceived safety level" subdimension, which is in 5-point Likert (1=very hazardous, 5=very safe)

Mueller, DaSilva, Townsend, & Tetrick (1999)
Safety Climate

Workplace

1. The reward system at my job promotes high performance even if it means acting unsafely.
2. My job duties often interfere with my ability to comply with safety regulations.

Social

1. The best workers in the group expect other workers to behave safely.
2. Employees in my work group comply with safety regulations.
3. The best workers in the department care about safety.
4. Workers who work safely try to emphasize it and make sure others appreciate it.
5. Employees in my work group remind each other of the need to follow safety regulations.
6. Where I work, workers who violate safety regulations irritate their fellow workers even when no harm has resulted.

Incentives

1. In this organization, good performance depends on safety training.
2. My supervisor negatively evaluates workers who behave recklessly.
3. When a worker violates safety regulations, it has an adverse impact on the supervisor's evaluation of the worker even when no harm was caused.
4. In my facility, compliance with safety regulations is part of employees' annual written evaluations.
5. Within this organization, workers who take safety training courses have a better chance for promotion than those who don't take safety training.
6. Workers who behave safely have a higher chance for promotion than those who don't.

7. In this organization, being involved in an accident has an adverse effect on the worker's reputation.
8. In this organization, a worker's safety record is one of the main factors in promotion decisions.

Attitude

1. Our management is well-informed about safety problems.
2. Being involved in safety issues has a high priority in my organization.
3. Where I work, top management gets personally involved in safety activities.
4. Reporting safety violations is a common practice where I work.
5. My supervisor tells a worker who is doing something unsafe to stop.
6. Management views safety regulation violations very seriously even when they don't result in any apparent damage.
7. Our management acts quickly to correct safety issues.
8. Management is presently acting to make the work environment safer.
9. Management is willing to invest money and effort to improve safety level.
10. Safety issues are assigned high priority in management meetings in this organization.
11. Our management is well-informed about safety issues in this plant.
12. Management in this organization is willing to invest money and effort to improve the safety level in the workplace.
13. When a safety regulation is issued, we are expected to follow it.
14. When a manager realizes that a hazardous situation has been found he immediately attempts to put it under control.

15. My supervisor values workers' suggestions for correcting safety hazards.
16. Being reprimanded for a safety violation causes a worker to behave more safely.
17. Workers who use personal protective equipment are considered to be conscientious.
18. The protection of workers from occupational exposure to hazards is a high priority with management where I work.
19. Where I work, there is a safety committee.
20. Managers in this factory try to reduce risk levels as much as possible.
21. Plant management in this factory is always willing to adopt new ideas for improving the safety level.

Note: Dimensions come from factor analysis. Response format: 6-point categorical (a=not at all descriptive, b=to a small extent, c=to some extent, d=to a great extent, e=to a very great extent, f=not applicable).

NASA NonSupervisory Employee Safety Performance Survey (1998)

Safety Performance

Visible Management Leadership

1. My annual performance plan contains my requirements for helping achieve my organization's safety and health program goals.
2. Specific safety and health objectives have not been developed for my work area.
3. Safety committees, comprised of representatives from management, contractors, unions, and employees have been established to review site safety issues.
4. Senior management involves the safety committee in reviews of the effectiveness of the safety and health program.
5. I am familiar with the policies, goals, and objectives stated in the Agency Safety Initiative (ASI) Core Process Requirements (CPR).
6. Staff safety meetings, including all levels of the workforce, are regularly held at this site.
7. I believe that adequate safety staffing exists to carry out an effective safety and health program in my work area.

Employee Participation

1. Management has encouraged open communication about safety and health throughout the workforce.
2. Documentation of safety and health procedures and directives are kept up-to-date in my work area.
3. I am aware of and use the process for documenting safety and health discrepancies without fear of reprisal.
4. I am aware of my rights to contact OSHA with safety and health concerns without fear of reprisal.
5. I am not encouraged to identify hazards in my workplace.

6. I am encouraged and authorized to stop activities that present potential serious safety or health hazards.
7. I have the opportunity to review the hazards and controls identified in my workplace.
8. I am encouraged to provide inputs and suggestions for the purpose of improving the safety and health program in my work area.
9. Employees participate in planning safety inspections of facilities and operations in my work area.
10. I am encouraged to inspect my work area to identify safety and health issues.
11. Safety inspection results are made available to employees for review and information.
12. Loss producing mishaps and close calls are investigated by safety personnel and employees.
13. I am satisfied that any mishaps or close calls which may occur in my work area will receive thorough and complete investigation.
14. Corrective actions from mishap board investigations are provided to employees in my work area.

Implementation Tools

1. Supervisory responsibility for safety and health issues in my work area is clearly defined.
2. My management recognizes and supports my defined safety responsibilities.
3. My job safety accountability has been clearly defined, and is equal with my other job responsibilities.
4. Management recognizes and supports the safety department responsibilities for my work area.
5. The information necessary for me to carry out my responsibilities for the safety and health program is available in my work area.

6. In my opinion, the budget for safety and health is not adequate to meet the needs of my work area.
7. The safety organization in this facility meets the safety and health needs of the daily operations in my work area.
8. Safety and health representatives have expertise appropriate to facility size and processes.

Survey and Hazard Analysis

1. I am aware of, or am involved in, the development of plans and schedules for activities to identify hazards associated with the facilities and operations in my work area.
2. Regular surveys, which include employee representatives such as myself, are conducted to carry out comprehensive safety hazard evaluations.
3. Employees are involved in the identification and elimination of hazards identified during the development and modification of job/task processes in their work area.
4. Hazard elimination is a goal of my work area.
5. When hazard elimination is not possible, other controls such as reduction of exposure, the use of barriers and guards, the use of personal protective equipment (PPE), and procedural work-around techniques are used.

Inspection

1. Employee input into facility inspections in my work area is encouraged.
2. Safety inspections are performed in my work area and the results are documented.
3. Safety inspection results are reviewed and compared with close calls, hazard reports, and mishap report closeouts.

Reporting

1. I am familiar with the hazards and close-call tracking systems and have access to the information contained in them.
2. I am familiar with the system for formally documenting hazards in my work area.

3. Open hazards or safety issues which affect employees in my work area are made known to workers.
4. Walk-down inspections are utilized by the workforce to identify and correct hazards.
5. Management encourages workers to identify and report safety hazards.
6. I am encouraged to report close-calls or near misses which occur in my work area.

Mishap Investigation

1. All loss producing mishaps and near misses that occur in my work area are investigated to determine root cause.
2. Employees from my work area participate in mishap and close-call investigations.
3. Employees in my work area are informed regarding the implementation status of mishap investigation recommended corrective actions.
4. There is a clear top-down commitment to mishap avoidance in my work area.
5. Safety information regarding mishaps and near-misses in my work area is made available to employees.
6. The safety program organization provides thorough investigation of mishaps and near-misses which occur in my work area.

Data Analysis

1. I have access to information regarding the results of safety analyses and any mishap prevention activity which is carried out in my work area.
2. An analysis to identify high risk problem areas and jobs has been conducted in my work area.
3. I am provided access to the statistical analysis of injury and illness records in my work area.
4. I am made aware of the status of open safety and health issues in my work area.

Hazard Control

1. I am aware analyses are conducted to control hazards in my workplace and that they are reviewed for adequacy.

2. Adherence to NASA, OSHA, and industry standards for hazard control is required in my work area.
3. The equipment necessary to effectively control the hazards in my workplace is in place and periodically inspected.

Maintenance

1. I am confident that each piece of equipment that I use is adequately maintained and is safe to operate.
2. I am provided with adequate operating procedures, which include safety hazard information, for each piece of equipment that I operate.

Medical Program

1. If identified as a job requirement, I receive physical examinations consistent with specific medical requirements associated with my job.
2. Health assessments are conducted in my work area to assure a healthy work environment.
3. Any critical or hazardous operations which are required in my work area are supported by professional health care providers.
4. When unique health issues (air quality, water quality, asbestos, etc.) are identified in my work area, adequate investigation is provided to analyze and resolve the issues to the satisfaction of employees.
5. If required, a documented Personal Protective Equipment (PPE) program, including fit and maintenance, is in place and strictly enforced in my work area.
6. Safety equipment utilized in my work area is supported by complete procedural documentation and appropriate training.
7. Compliance with industry and OSHA standards is required in my work area.

Emergency Preparedness

1. I am made aware of emergency response plan updates in my work area.

2. Emergency response plans are re-evaluated at least annually.
3. Emergency procedures exist for all potential hazards in my work area.
4. I participate in regular drills to validate emergency procedures.
5. I am concerned that the equipment available at this facility may not be adequate to control all identified emergencies.
6. Natural disaster emergency response plans (severe weather, fire, etc.) exist for my work area.

First Aid/Emergency Care

1. Personnel trained in fire and rescue are always available to my worksite.
2. Appropriate fire and rescue equipment is available to my worksite.
3. Trained personnel provide emergency services for my worksite which include provisions for ambulance, EMT's, or emergency rooms.
4. It is my belief that response time to my worksite of appropriate emergency equipment and personnel will be at a minimum.
5. Employee personnel trained in first-aid and medical care are always available to my worksite.

Safety and Health Training

1. An individual training plan has been developed that documents the training requirements for my job.
2. My employee training plan is updated to reflect changes in facilities or processes and to enhance employee safety awareness.
3. My training covers all necessary topics, operations, and hazards identified for my job.
4. Knowledgeable persons conduct safety and health training courses.
5. I am always notified of my retraining, makeup training, and training modification requirements.
6. If required on my job, my recertification requirements are documented and tracked.

7. If required, my individual certification plan is based on job requirements defined by applicable standards, worksite hazard identification, and workplace analysis.
8. All new hires are provided a formal orientation program to recognize hazards, violation of standards, and facility safety practices.
9. If required, I have received instruction from persons knowledgeable of Personal Protective Equipment (PPE) and must regularly demonstrate proficiency in equipment use through drills and simulations.
10. A training program is provided for me which includes training in hazard identification, program violations, equipment operations, and first-aid training.
11. Training in the operation of any unique equipment which I may be required to use is adequate.
12. Employees in my work area are encouraged to assist in developing training requirements.
13. Employees from my work area provide inputs into recurrency training requirements.
14. Employees participate, in establishing certification requirements for those jobs for which certification is required.

Note: Response format: 5-point Likert (1=strongly disagree, 5=totally agree with N/A and “Don’t know” options)

Ostrom, Wilhelmsen & Kaplan (1993)
EG&G Idaho Safety Norms Survey

Safety Awareness

1. In our company, the employees are aware of their part in safety.
2. In our company, people think safety concerns do not relate to office workers.
3. People are well aware of the safety hazards in their area and are careful to minimize and avoid them.
4. Around here, people don't think much about safety.

Teamwork

1. Safety professionals in this company tend to be bright and capable people.
2. In this company, people ask for help with safety when they need it.
3. Around here, you'll be better off if you hide your problems and avoid your supervisor.
4. People do go out of their way to help each other work safely.
5. Safety personnel are unavailable when we need help.
6. Around here, employees who have to follow safety and health procedures are seldom asked for input when the procedures are developed or changed.

Pride & Commitment

1. Around here, people take pride in how safely we operate.
2. In this company, people stand up for the safety of their operations when others criticize it unfairly.
3. Around here, people look at the company safety record as their own safety record and take pride in it.
4. In this company, I cannot significantly impact the company's safety record.
5. In this company, people think safety isn't their concern - it's all up to their manager and others.

6. Around here, people see safety as the responsibility of each individual.
7. This company cares about the safety of its employees.

Excellence

1. In this company, we have the highest standards for safety performance.
2. Around here, people are always trying to improve on safety performance, even when they are doing well.
3. People are often satisfied with routine and mediocre consideration for safety.
4. Around here, the way we work now is safe enough.
5. In this company, there is no point in trying harder to be safe; no one else is.

Honesty

1. In this company, people work safely, even when the boss isn't looking.
2. Around here, people wear safety equipment even when they know they aren't being watched.
3. Around here, people are willing to comply with safety measures and regulations.
4. In this company, people try to get around safety requirements whenever they get a chance.

Communications

1. In this company, we hesitate to report minor injuries and incidents.
2. We don't get adequate information about what is going on with safety in the company.
3. Around here, there's lots of confusion about who to contact for safety concerns.
4. Around here, safety statistics are seldom studied and discussed.
5. In our company, safety standards are seldom discussed openly.

6. Timely feedback is seldom provided when a safety hazard is reported.
7. In this company, you cannot raise a safety concern without fear of retribution.
8. In this company, we have very few safety signs or posters.
9. Around here, employee ideas and opinions on safety are solicited and used.
10. People who raise safety concerns are seen as troublemakers.

Leadership & Supervision

1. It's a tradition: safety matters are given a low priority in meetings.
2. In our company, managers don't show much concern for safety until there is an accident.
3. In this company, the people who make safety decisions don't know what is going on at the workers' level.
4. Around here, work is organized so that you can do the job safely.
5. Around here, managers seldom work with their groups to identify and correct safety concerns or problems.
6. In our company, employees who will implement plans are seldom involved in reviewing their safety implications.
7. Managers/supervisors are often not available to answer health and safety questions.
8. My manager/supervisor discussed safety and health issues in my last employee evaluation.
9. Supervisors are receptive to learning about safety concerns.
10. In this company, people who work safely get no real rewards.
11. Little special recognition is given to safe employees.

Innovation

1. Around here, people are constantly on the lookout for ways of doing things more safely.

2. People tend to hang on to the old ways of doing things without regard to their safety implications.
3. In this company, people are encouraged to express new safety ideas and suggestions.
4. Around here, you get little recognition for new safety ideas.
5. It's a tradition: you don't raise safety ideas that your boss doesn't have first.

Training

1. People mostly give lip service to safety training; they do little to actively support it.
2. In this company, safety training is compromised in favor of more pressing demands.
3. Around here, managers are not very well trained to identify and address safety concerns.
4. In this company, safety training doesn't address subjects of real concern.
5. It's a tradition: safety training is done on a regular basis.
6. People in this company are well prepared for emergencies, and everyone knows just how to respond.
7. I know who to talk to when I see a hazard or have health and safety concerns.

Customer Relations

1. Employees here are always looking for ways to satisfy the customers' needs and requirements.
2. Customers here count on our company to do its work safely.

Procedure Compliance

1. In this company, we have a long way to go in improving our compliance.
2. In this company, people are often uncertain about what the safety procedures are for the work they do.
3. In general, people are well acquainted with the safety procedures for their job.
4. In this company, the safety procedures are relevant to employees' particular circumstances.

5. Around here, there are lots of safety procedures that don't really apply to the particular areas or circumstances in which they are supposed to be used.
6. There are so many procedures that they interfere with doing a job safely.
7. In this company, area requirements for protective clothing and equipment may not reflect the actual hazards.
8. In this company, employees use their heads and raise lots of questions about why things are being done the way they are.
9. In this company, procedures are too detailed, making compliance a mindless activity.
10. It's a tradition: people carefully follow the written procedures.
11. In this company, people can be confident they are safe when they are following the rules.
12. Around here, you can't expect praise and recognition for complying with procedures.
13. In this company, following safety procedures is consistently expected.
14. Safety procedures tend to be too vague and general to apply in specific situations.

Safety Effectiveness

1. When it comes down to it, people in this company would rather take a chance with safety than miss a schedule or budget commitment.

2. In this company, people are willing to expend a great deal of effort to get a job done safely.
3. In this company, work is not done that jeopardizes other workers or the public.
4. Employees rarely take the initiative to get safety problems taken care of.
5. Around here, people can report a safety problem several times, yet the problems may remain and not get corrected.
6. Our daily routines don't show that safety is an important value.

Facilities

1. In this company, the physical conditions of work locations inhibit safe work.
2. In this company, facilities are designed with safety in mind.
3. Concern and attention is being given to maintaining good safety conditions in our facilities.
4. People tend to keep their facility neat and orderly.
5. Around here, good housekeeping isn't just the janitor's job - people clean up their own areas.
6. In this company, fire and electrical hazards are accepted in some of our facilities.
7. Around here, we really keep on top of the snow and ice problems and prevent them from getting out of hand.

Note: Response format: 5-point Likert (1=strongly disagree, 2=disagree, 3=neither disagree nor agree, 4=agree, 5=strongly agree)

Pizzi, Goldfarb, & Nash (2001)
Patient-Safe Environment

1. All people acknowledge that top management provides essential (crew/pilot) safety improvement leadership.
2. The organization has clearly defined (crew/pilot) safety policies.
3. All people can explain the organization's (crew/pilot) safety policies.
4. All people are involved in developing (crew/pilot) safety goals, and everyone can explain desired results and measures.
5. All people are actively involved in identifying and resolving safety concerns.
6. All people can explain how their personal performance affects (airline) safety.
7. All people believe they have the necessary authority and resources to meet their responsibilities for (crew/pilot) safety.
8. (crew/pilot) safety performance for all people is measured against goal, clearly displayed, and rewarded.
9. A comprehensive review of (crew/pilot) safety is conducted annually, and there is a process in place that drives continuous improvement.
10. Regular workplace hazard analyses are conducted to identify (crew/pilot) safety improvement opportunities. The results are used to make changes in (crew/pilot) activities.
11. All people are empowered to correct (crew/pilot) safety hazards as they are identified.
12. A comprehensive system exists for gathering information on (crew/pilot) safety hazards. The system is positive, rewarding, and effective, and people use it.
13. All people are fully aware of (crew/pilot) incident trends, causes, and means of prevention.
14. All injury-producing (crew/pilot) incidents and significant "near misses" are investigated for root cause, with effective preventive actions taken.
15. All people who operate (crew/pilot) equipment are trained to recognize maintenance needs and perform or request timely maintenance.
16. All people know immediately how to respond to an emergency because of effective planning, training, and drills.
17. Facilities are fully equipped for emergencies; all necessary systems and equipment are in place and regularly tested; and all people know how to use equipment and communicate during emergencies.
18. Ergonomics experts are provided when needed and are involved in (crew/pilot) safety assessment and training.
19. All supervisors/managers assist in (crew/pilot) safety workplace analyses, ensure physical protections, reinforce training, enforce discipline, and can explain how to provide safe (crew/pilot) care.

Note: No subdimensions. Response format is not given.

Prosafe Solutions, Inc.
Organizational Safety Culture

1. Your safety director reports directly to the President or CEO of the company.
2. Roles and responsibilities for safety are clearly defined and included in management and employee job descriptions.
3. Specific safety goals are set and measured for each operating unit.
4. Safety performance is measured and linked to performance pay.
5. Management is held accountable for ensuring safety issues are resolved.
6. The company identifies safety as a core value similar to other values such as customer service, production, and quality initiatives.
7. My employees have the ability to stop activities due to safety concerns.
8. Management and supervisors model safety behavior in all aspects of their job.
9. Investigations are conducted to find who was at fault during an accident.
10. Near misses are not reported since not all accidents are preventable.
11. Employees are comfortable about reporting safety problems.
12. Management is responsive in correcting safety hazards immediately after they are discovered.
13. Employees come to you about concerns they have with safety.
14. Your company has an employee suggestion program that compensates for ideas.
15. Supervisors are trained to provide positive feedback to workers.
16. Supervisors praise workers for working safely.
17. Your management staff receive continuous training in leadership techniques.
18. All company employees model safety by following safety rules.
19. Employees are well trained on all procedures, equipment, and safety rules.
20. Emergency plans, drills and procedures are updated and practiced routinely.

Note: No subdimensions. Response format: Yes/No.

Rybowiak, Garst, Frese, & Batinic (1999)
Error Orientation

Error Competence

1. When I have made a mistake, I know immediately how to correct it.
2. When I do something wrong, at work, I correct it immediately.
3. If it is at all possible to correct a mistake, then I usually know how to go about it.
4. I don't let go of the goal, although I may make mistakes.

Learning From Errors

1. Mistakes assist me to improve my work.
2. Mistakes provide useful information for me to carry out my work.
3. My mistakes help me to improve my work.
4. My mistakes have helped me to improve my work.

Error Risk Taking

1. If one wants to achieve at work, one has to risk making mistakes.
2. It is better to take the risk of making mistakes than to "sit on one's behind".
3. To get on with my work, I gladly put up with things that can go wrong.
4. I'd prefer to err, than to do nothing at all.

Error Strain

1. I find it stressful when I err.
2. I am often afraid of making mistakes.
3. I feel embarrassed when I make an error.
4. If I make a mistake at work, I "lose my cool" and become angry.
5. While working I am concerned that I could do something wrong.

Error Anticipation

1. In carrying out my task, the likelihood of errors is high.

2. Whenever I start some piece of work, I am aware that mistakes occur.
3. Most of the time I am not astonished about my mistakes because I expected them.
4. I anticipate mistakes happening in my work.
5. I expect that something will go wrong from time to time.

Covering Up Errors

1. Why mention a mistake when it isn't obvious?
2. It is disadvantageous to make one's mistakes public.
3. I do not find it useful to discuss my mistakes.
4. It can be useful to cover up mistakes.
5. I would rather keep my mistakes to myself.
6. Employees who admit to their errors make a big mistake.

Error Communication

1. When I make a mistake at work, I tell others about it in order that they do not make the same mistake.
2. If I cannot rectify an error by myself, I turn to my colleagues.
3. If I cannot manage to correct a mistake, I can rely on others.
4. When I have done something wrong, I ask others how I should do it better.

Thinking About Errors

1. After I have made a mistake, I think about how it came about.
2. I often think: "How could I have prevented this?"
3. If something goes wrong at work, I think it over carefully.
4. After a mistake has happened, I think long and hard about how to correct it.
5. When a mistake occurs, I analyze it thoroughly.

Note: Response format is not given.

Yule, Flin, & Murdy (2001)
Safety Climate

Upper Management Commitment to Safety

1. The company cares about the health and safety of the people who work here.
2. Senior management take health and safety seriously.
3. There are good communications here about health and safety.
4. Suggestions to improve health and safety are seldom acted upon.

Implementation of Procedures

1. Some jobs are difficult to do safely.
2. Some health and safety procedures/instructions/rules are not really practical.
3. Some physical conditions at the workplace restrict people's ability to work safely.
4. Some health and safety procedures/instructions/rules are difficult to follow.

Health and Safety Knowledge

1. Some people have a poor understanding of the risks associated with their work.
2. People here think health and safety isn't their problem - it is up to management and others.
3. Some of the workforce pay little attention to health and safety.
4. People here do not remember much of the health and safety training which applies to their job.

Team Cohesion

1. I trust my workmates with my health and safety.
2. It is important for me to work safely if I am to keep the respect of others in my team.
3. All the people who work in my team are committed to health and safety.

4. My workmates would react strongly against people who break health and safety procedures/instructions/rules.

Team Leader Involvement

1. My immediate boss is receptive to ideas on how to improve health and safety.
2. I don't think my immediate boss does enough to ensure health and safety.
3. My immediate boss would be very helpful if I asked for advice on health and safety matters.

Individual Responsibility

1. I fully understand the health and safety risks associated with the work for which I am responsible.
2. I fully understand the health and safety procedures/instructions/rules associated with my job.
3. I am clear what my responsibilities are for health and safety.

Permit-to-Work

1. The permit-to-work system causes unnecessary delays in getting the job done.
2. The permit-to-work system is "over the top" given the real risks of some of the jobs it is used for.
3. The permit-to-work system is always strictly applied and followed.

Accountability

1. People who cause accidents here are not held sufficiently accountable for their actions.
2. Action is seldom taken against people who break health and safety procedures/instructions/rules.

Note: Response format: 5-point Likert (1=strongly disagree, 5=strongly agree).

Zohar (2000)
Group Safety Climate

Action

1. My supervisor says a good word whenever he sees a job done according to the safety rules.
2. My supervisor seriously considers any worker's suggestions for improving safety.
3. My supervisor approaches workers during work to discuss safety issues.
4. My supervisor gets annoyed with any worker ignoring safety rules, even minor rules.
5. My supervisor watches more often when a worker has violated some safety rule.

Expectation

1. As long as there is no accident, my supervisor doesn't care how the work is done.
2. Whenever pressure builds up, my supervisor wants us to work faster, rather than by the rules.
3. My supervisor pays less attention to safety problems than most other supervisors in this company.
4. My supervisor only keeps track of major safety problems and overlooks routine problems.
5. As long as work remains on schedule, my supervisor doesn't care how this has been achieved.

Note: Response format: 5-point Likert (1=completely disagree, 5=completely agree).

Appendix B: Original CASS Scales & Items

Organizational Commitment:

I am confident that maintenance on aircraft is adequately performed and that aircraft are safe to operate.

Pilots are given enough training to perform their work safely.

Management doesn't show much concern for safety until there is an accident or incident.*

Safety is identified as a "core value" in my airline.

Checklists and procedures are easy to understand.

Management expects pilots to "push" the weather.*

Following safety procedures is consistently expected.

My airline's manuals are up to date.

Safety works until we are busy.*

Management tries to get around safety requirements whenever they get a chance.*

Management is willing to invest money and effort to improve safety.

My airline is more concerned with making money than being safe.*

Training practices at my airline are centered around safety.

Management views regulation violations very seriously, even when they don't result in any apparent damage.

Personnel responsible for safety hold a high status in my airline.

Some safety procedures/rules are not really practical.*

Safety is always discussed during training at my airline.

Management's view is that not all accidents are preventable.*

Management views FARs as a hindrance.*

Safety is emphasized by my airline during the interview and orientation process.

It is hard for pilots here to maintain a consistent sleep schedule.*

My airline does all it can to prevent accidents or incidents.

When an accident occurs, management always blames the pilot.*

Management is committed to equipping aircraft with up-to-date technologies.

Pilots who are not feeling well or are tired are encouraged not to fly.

My airline does not cut corners where safety is concerned.

When it comes down to it, people in this airline would rather take a chance with safety than cancel a flight.*

Management Involvement:

Management involvement in safety issues has a high priority at my airline.

My airline only keeps track of major safety problems and overlooks routine ones.*

Flight Management closely monitors proficiency and currency standards to ensure pilots are qualified to fly their assigned flights.

My airline's safety department is doing a good job.

Upper level management gets personally involved in safety activities.

Safety standards are seldom discussed openly.*

Management is receptive to learning about safety concerns.

Management has a clear picture of the risks associated with flight operations.

Management often fails to recognize when pilots are flying unsafely.*

Results of FAA safety inspections are made available to pilots for review and information.

Safety issues are assigned high priority in meetings in this airline.

Management stops unsafe operations or activities.

Management does not hesitate to approach pilots to discuss safety issues.

Pilots are kept informed of any changes that may affect safety.

Safety personnel are unavailable when pilots need help.*

Personnel responsible for safety have the authority to implement changes.

There are good communications here about safety.

* Item indicates a negative safety culture and is reverse coded for all analyses.

As long as there is no accident, management doesn't care how the flight operations are performed.*

Reward System:

Being involved in an accident or incident has an adverse effect on a pilot's future with this airline.

Airline management negatively evaluates pilots who behave recklessly.

Pilots shouldn't expect praise and recognition for complying with safety regulations, because safety is part of the job.

Safe pilot performance is evaluated using clear standards.

Pilots who cause accidents or incidents are not held sufficiently accountable for their actions.*

Our reward system promotes high performance even if it means acting unsafely.*

Action is consistently taken against pilots who violate safety procedures or rules.

Pilots get little recognition for new safety ideas.*

Being involved in an accident or incident has an adverse effect on a pilot's reputation.

Employee Empowerment:

Pilots are seldom asked for input when airline procedures are developed or changed.*

Pilots are actively involved in identifying and resolving safety concerns.

The best pilots in the group expect other pilots to behave safely.

Management ensures that all pilots are responsible and accountable for safe flight operations.

Pilots are given sufficient opportunities to make suggestions regarding safety issues.

Pilots do all they can to prevent accidents.

Pilots look at the airline's safety record as their own and take pride in it.

My airline rarely questions a pilot's decision to turn around due to weather.

Pilots who violate safety regulations upset other pilots even when no harm has resulted.

I am encouraged to stop flight related activities that are unsafe.

Peer influence is effective at discouraging violations of operating procedures and flying regulations.

Pilots try to get around safety requirements whenever they get a chance.*

It is important for me to fly safely if I am to keep the respect of other pilots in my airline.

Pilots often encourage one another to work safely.

Reporting System:

I am familiar with the system for formally reporting safety issues in my airline.

Pilots are willing to report information regarding safety violations, marginal aviator performance, or other unsafe behavior.

Safety issues raised by pilots are communicated regularly to all pilots in the airline.

This airline's safety program includes mechanisms for me to report safety deficiencies.

Pilots do not report their own mistakes when they are not obvious.*

Pilots hesitate to report minor injuries and incidents.*

It is best to remain anonymous when reporting an unsafe condition or incident.*

When a pilot reports a safety problem, management acts quickly to correct safety issues.

Pilots who raise safety concerns are seen as troublemakers.*

Pilots can report safety discrepancies without the fear of negative repercussions.

Pilots who admit their errors make a big mistake.*

There is no point in reporting a near miss.*

I am satisfied with the way this airline deals with safety reports.

* Item indicates a negative safety culture and is reverse coded for all analyses.

Appendix C: Abbreviated CASS Scales

Organizational Commitment:

Management doesn't show much concern for safety until there is an accident or incident.*

Management expects pilots to "push" the weather.*

Following safety procedures is consistently expected.

Safety works until we are busy.*

Management tries to get around safety requirements whenever they get a chance.*

Management is willing to invest money and effort to improve safety.

My airline is more concerned with making money than being safe.*

My airline does all it can to prevent accidents or incidents.

My airline does not cut corners where safety is concerned.

When it comes down to it, people in this airline would rather take a chance with safety than cancel a flight.*

Management Involvement:

Management involvement in safety issues has a high priority at my airline.

My airline's safety department is doing a good job.

Upper level management gets personally involved in safety activities.

Safety standards are seldom discussed openly.*

Management is receptive to learning about safety concerns.

Safety issues are assigned high priority in meetings in this airline.

Management stops unsafe operations or activities.

Management does not hesitate to approach pilots to discuss safety issues.

Pilots are kept informed of any changes that may affect safety.

There are good communications here about safety.

Reward System:

Being involved in an accident or incident has an adverse effect on a pilot's future with this airline.

Airline management negatively evaluates pilots who behave recklessly.

Safe pilot performance is evaluated using clear standards.

Pilots who cause accidents or incidents are not held sufficiently accountable for their actions.*

Our reward system promotes high performance even if it means acting unsafely.*

Action is consistently taken against pilots who violate safety procedures or rules.

Employee Empowerment:

Pilots are seldom asked for input when airline procedures are developed or changed.*

The best pilots in the group expect other pilots to behave safely.

Management ensures that all pilots are responsible and accountable for safe flight operations.

Pilots do all they can to prevent accidents.

Pilots look at the airline's safety record as their own and take pride in it.

I am encouraged to stop flight related activities that are unsafe.

Peer influence is effective at discouraging violations of operating procedures and flying regulations.

Pilots try to get around safety requirements whenever they get a chance.*

It is important for me to fly safely if I am to keep the respect of other pilots in my airline.

Pilots often encourage one another to work safely.

* Item indicates a negative safety culture and is reverse coded for all analyses.

Reporting System:

I am familiar with the system for formally reporting safety issues in my airline.

Safety issues raised by pilots are communicated regularly to all pilots in the airline.

Pilots hesitate to report minor injuries and incidents.*

It is best to remain anonymous when reporting an unsafe condition or incident.*

When a pilot reports a safety problem, management acts quickly to correct safety issues.

Pilots who raise safety concerns are seen as troublemakers.*

Pilots can report safety discrepancies without the fear of negative repercussions.

Pilots who admit their errors make a big mistake.*

There is no point in reporting a near miss.*

I am satisfied with the way this airline deals with safety reports

* Item indicates a negative safety culture and is reverse coded for all analyses.