Measuring Safety Culture in a Non-Us Airline Using the Commercial Aviation Safety Survey

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MEASURING SAFETY CULTURE IN A NON-US AIRLINE USING THE COMMERCIAL AVIATION SAFETY SURVEY

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The purpose of this present study was twofold: firstly to test the psychometric appropriateness of the Commercial Aviation Safety Survey (CASS) for flight operations developed at the University of Illinois, in non-US environment, and secondly to assess the current state of organizational safety culture at a European airline. To achieve these objectives the CASS was administered in a web-based format to the flight operations department at a major European air carrier. The respondents reflected a representative employee distribution and a response rate of 31 percent. The internal consistency of the CASS indicated adequate reliability (all scores above 0.70). The survey revealed a generally positive safety culture that was broadly speaking, average, with the perception that management tended to lean toward delegating safety responsibilities to others in some areas and leaned toward collaborative safety efforts in other areas. The safety culture at this airline appears to be strongest in the areas of Middle Management (e.g. operations personnel) and weakest in the area of Organizational Commitment (e.g. going beyond compliance). Findings also show significant negative correlations between employees at the airline fifteen years or less and their perceptions of the airline's safety culture. We compared these results to that of a US based airline. It is evident that this survey is capable of distinguishing between different safety cultures whether in America or Europe. Methodological considerations and improvements to the survey are also discussed.

Introduction

Highly advanced technological systems, such as those in modern commercial aviation, are vulnerable to the effects of poor organizational safety culture (Reason, 1998). Surveys and questionnaires have been widely used to assess safety in variety of complex and high risk indiustries but few comprehensive measures of safety culture have been developed for the commercial aviation industry. A comprehensive safety culture survey is the first step in allowing airlines to take a proactive approach to safety culture, rather than the reactive approach that results from accident analysis (Gibbons, von Thaden & Wiegmann, 2006). An airline might use a survey to obtain a broad overview of safety culture needs, then target any identified problem areas with more in-depth, qualitative investigations. In this way, the most urgent problems can be addressed first. Airlines can survey their employees routinely to evaluate the efficacy of safety programs previously implemented, or as an instrument to provide decision support in times of significant organizational change. For example, two airlines undergoing a merger could greatly benefit from understanding the safety culture of each organization before the merger. This would allow management to make informed decisions about future policies or anticipate potential incompatibilities between the two organizations. A complete, valid measure of safety culture is also needed to advance theory and research (Gibbons et. al., 2006).

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Method

Apparatus/materials

In recent years the Commercial Aviation Safety Survey (CASS) has been developed and validated at the University of Illinois (Wiegmann et al., 2002 and 2003; Gibbons, et al., 2004). This survey is used to measure current state, strengths and weaknesses of organizational safety culture in aviation operations. The CASS is a 55 item survey that was developed to assess four global components or dimensions of safety culture within the commercial aviation industry. These components, depicted in Figure 1, are: *Formal Safety System*, *Informal Safety System*, *Operational Personnel*, and *Organizational Commitment*. Under every component there are three subscales consisting of 4 to 5 items each.

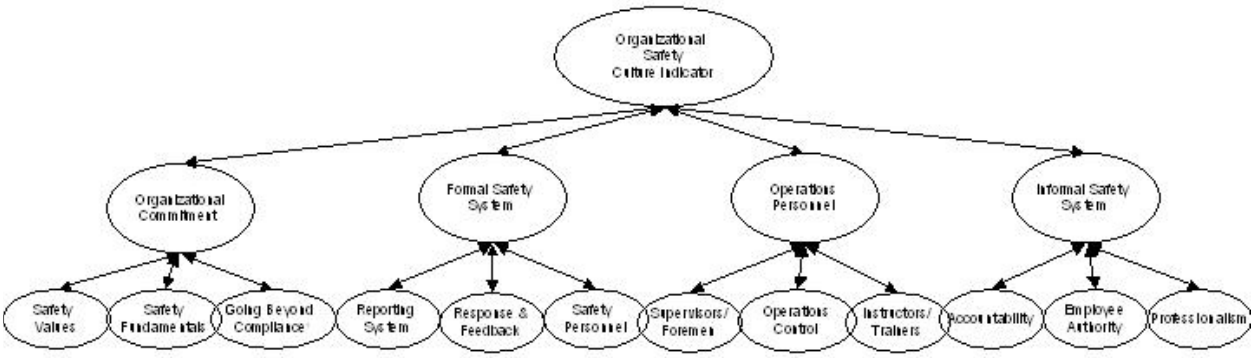

***Figure 1* – The Safety Culture Model (from Gibbons, von Thaden and Wiegmann, 2004).**

The survey questions are rated on a 7-point Likert response scale, ranging from 1 *strongly disagree* to 7 *strongly agree*, with 4 representing *neither agree nor disagree*. Space for respondents to write comments were provided after each section and a *General Comments* section was included at the end of the questionnaire. Ten additional items assess the pilots' perception of risk and safety behavior at their airline, with items asking about the likelihood of an accident or incident occurring at the airline. Further, two additional questions regarding safety in ground handling were in this administration of the survey. A brief demographic section included at the end of the survey provides additional information about the respondents. Participants may indicate their position (pilot or management), tenure with the company, tenure in their present position, the appropriate age bracket, type of aircraft flown for the company, and whether they have reported a safety problem at their present airline.

Procedure

A large commercial air carrier agreed to participate in this survey. A draft version of the CASS was shared among the top administration to give the managers an opportunity for input into the vernacular specific to their airline. The background information was tailored slightly to match the air carrier's definitions of management and personnel within their organization. The survey was administrated online through a survey website hosted at the University of Illinois. The survey was administrated to 240 pilots and 20 supervisors/managers through an email. The email including two cover letters was sent to airline employees; one from the researchers explaining the purpose of this research and another from the Director of Flight Operations encouraging employees to participate. Participants were assured of their anonymity. Participation was voluntary and no remuneration was given to participants. The email also had the hyperlink to a website were the respondents could answer the survey electronically preferably within next two weeks. . Participants were provided a secure URL to log into the CASS. A reminder was sent after two weeks, four weeks. The international language in aviation is English and therefore the survey was administrated in English and the respondents answered the survey in English.

Participants

The response rate to the survey was approximately 31 percent. Thirty-eight respondents (45.8%) described their primary job responsibility as *Commander*, another forty (48.2%) respondents as *Co-Pilot* and five as *Supervisor/Manger* or *Other*. To prevent 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 supplied, rather than an exact figure. The majority (67.5%) of the respondents were between 31 and 50 years of age. Fifty-five percent of respondents have been employed by the airline between one and ten years.

Results

The internal consistency alpha coefficients were moderately high indicating adequate reliability for each of the four safety culture dimensions, see Table 1. The lowest value is 0.71 for *Informal Safety System* while the highest alpha value is 0.90 on the *Organizational Commitment* scale. The reliability coefficient as measured by Cronbach's alpha for the four dimensional instrument is 0.87, which is acceptable.

The overall reliability for the 12 subscales is 0.90 which is satisfactory. The correlations between subscales are not too high (highest 0.66) indicating that the subscales are measuring different constructs.

Table 1 - Reliability of Safety Culture Dimensions.

Dimensions (Abbriviation)	#of items	Alpha
Formal Safety System (*FSS*)	14	0.84
Informal Safety System (*ISS*)	14	0.71
Operational Personnel (*OP*)	13	0.73
Organizational Commitment (*OC*)	14	0.90
Overall reliability	55	0.87

Comparatively, Gibbons et. al. (2004) performed a previous validation study at a US airline using their original 5-factor model which was subsequently updated to reflect the current 4-factor model construct. The reliability coefficients for the two studies are not directly comparable since the items behind each subscale are not in all cases the same, yet each shows suitable acceptable reliability.

In the current study, there is a significant negative correlation ($p<0.05$) between younger employees that have been at the airline for fifteen years or less and their perceptions of the airline's safety culture. However, this perception was not significant in consideration of all respondents. There is also a negative correlation between how many years the respondent has spent at the current job within the company and the perception of safety culture. This is also significant ($p<0.05$) for employees that have been in their current job for ten years or less. The reason behind this is worth exploring with the aim of mitigating the apparent declining attitude found among the pilots, especially, in the middle age group. This is an interesting finding worthy of future research.

The Safety Culture Grid

To facilitate the comparison and interpretation of different aviation safety cultures, a safety culture grid (see Figure 2) is used to summarize the strengths and weaknesses at a given organization. Blake and Mouton (1964) originally developed a grid to assess the managerial style from which principles were adopted to approximate safety culture on a multidimensional continuum or grid.

Safety culture may be best represented outside the realm of linear configuration, rather within a continuum of related variables, factored in concert with managerial and employee perceptions revealing the true characteristics of the organizational safety culture. 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. The safety culture grid is indicative of the values placed on worker safety and protocols. This grid configuration allows an organization to strategically map its position, 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.

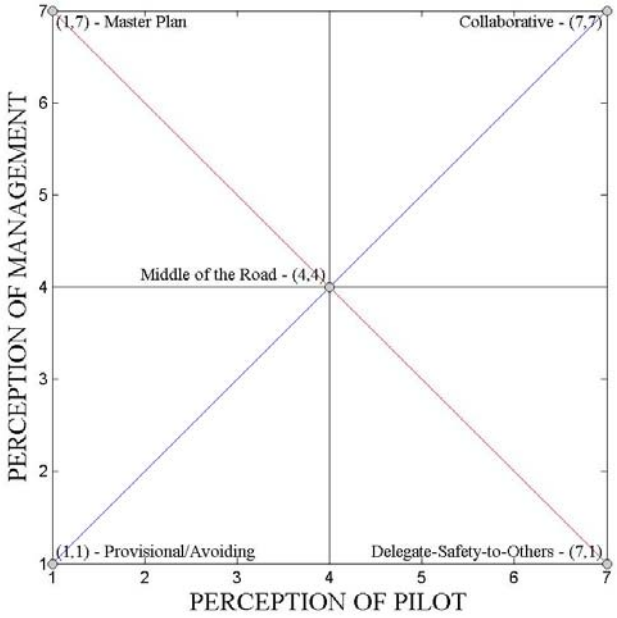

Figure 2 – The Safety Culture Grid

Five ranges were identified on which to plot safety culture perceptions. These ranges represent a fusion of strategic management science and organizational behavior principles (Brodwin & Bourgeois, 1984; Thompson & Strickland, 1993) and are described in Table 2. Five general types of organizations have been described by plotting management's and pilot's perceptions of safety culture in a grid. The description of each type can be seen in great detail in Wiegmann et al (2003).

The Safety Culture Grid shown in Figure 3 summarizes the safety culture information as characteristics of the study airline. The figure reveals an organization with a positive *Collaborative* safety culture that tends toward *Middle of the Road*. The pilots valuate the safety culture a little higher than the management. Hence, all the dimensions lie beneath

Table 2 – Organizational Features in Safety Culture Dimensions

Organizational Type	*Key Factors*
Collaborative	*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 and *Looking for ways to develop a v win situation.
Master Plan	*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 and *Safety-by-the-Rules.
Delegate-Safety-to-Others	*High employee assertiveness, *Employees entrusted with settin safety standards, *Employees have pride in compa safety record, *Staff specialists utilized, *Works well with highly skilled, educated, and experienced employees, *Based on personal experience and *Laissez faire management.
Provisional/ Avoiding	*Avoidance: low assertiveness, low cooperation, *Do-it-yourself, *Ad-hoc, *Unplanned and *Vague.
Middle-of-the-Road	*Compromising a moderate assertiveness and cooperation and *Accommodating: low assertiveness, high cooperation.

the blue line. There is a weak tendency towards *Delegate-Safety-to-Other*s (*Organizational Commitment*).

This tendency is, however, not statistically significant ($p>0.05$) for all the safety culture dimensions. It is evident looking at the figure that management must especially target issues regarding *Organizational Commitment* but also *Formal Safety System* and *Informal Safety System*, if they are to improve or enhance their collaborative approach to safety. It appears the pilots feel they have more of the responsibility but not the authority or feel confident they can change things. Overall, it is not *bad* but it could be better. According to the analysis on the *Organizational Commitment* dimension there is suggestion that the commitment to safety, equipment and technology could be improved at the airline.

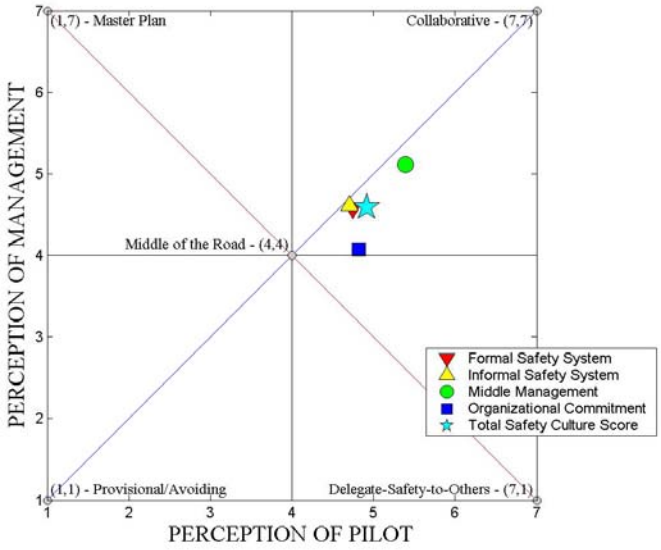

Figure 3 – Safety Culture Grid for the CASS dimensions in a non-US airline.

Safety culture at an US-airline is shown on Figure 4 for comparison (Wiegmann et al, 2003). The model used is the original five-factor model and therefore the safety culture dimensions are different to the four-factor model used in this study, but representative of the dimensions nonetheless. The Safety Culture Grid demonstrates an organization that values a c*ollaborative*, team environment. All dimensions lie above the blue line except for the red circle which is *Reward Systems*. In this case the dimension is almost on the blue line. The fact that the dimensions are above the blue line indicates a tendency towards *Master Plan* with higher managerial than employee assertiveness. In this case it appears that management should especially target issues regarding *Reward Systems* if they are to improve or enhance their collaborative approach to safety. The two airlines have different safety cultures.

This is evident by comparing Figures 3 and 4. The airline in this study has a tendency towards *Delegate-Safety-to-Other*s but the airline for comparison towards *Master Plan.* Both are tending towards Collaborative even though the study airline can be characterized as tending toward *Middle of the Road.*

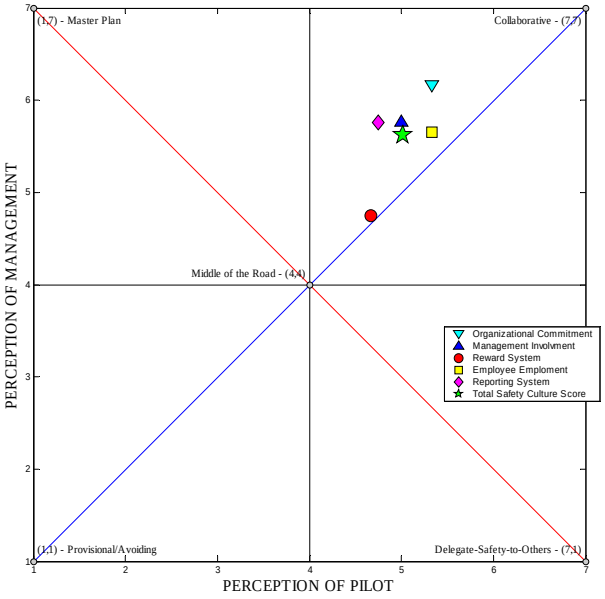

Figure 4 – Safety Culture Grid for the dimensions in the original five-factor CASS model for a US-airline.

The CASS subscales have been represented in the Grid in Figure 5. This gives a more detailed demonstration of the safety culture at the airline as it reflects the variability of the subscales that indicate the safety culture dimensions. It is clear that the subscales reflect a safety culture that is *Middle of the Road* with the exception of two subscales: *Chief Pilots* and *Instructors/Trainers*.

In the *Middle of the Road* safety culture the pilots get mixed messages from the management: On the one hand safety is consistently emphasized during training but on the other hand instructors may teach shortcuts and ways to get around safety requirements. This supports that the safety culture is more *Middle of the Road* than *Collaborative* with a tendency towards *Delegate-Safety-to-Others*. This tendency is, however, not statistically significant (p>0,05). Possibly, because overall it is agreed that the safety culture is positive but in need of improvement.

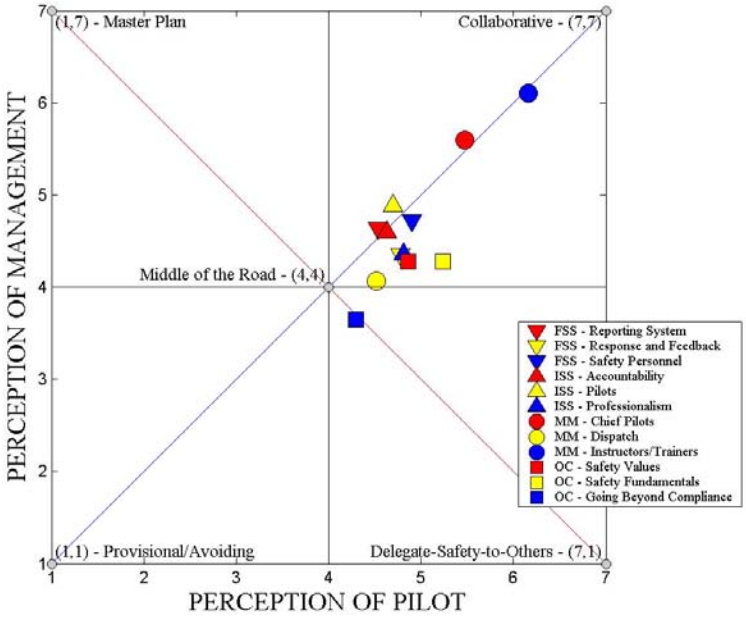

Figure 5 – Safety Culture Grid for the CASS subscales in the non-US airline.

Between pilots and management on the subscale *Safety Fundamentals* there is almost a significant difference $F(1,82) = 3.65$, p=0.06. Management must target issues regarding *Going Beyond Compliance*, *Safety Fundamentals* and *Dispatch*. It would also be wise to improve response and feedback between management and pilots, safety values and professionalism. Again this indicates that the safety culture is clustering around the middle with tendency towards *Collaborative* (*Operational Personnel*) and *Delegate-Safety-to-Others* (*Organizational Commitment*). There is room for much improvement in various areas as said before.

Discussion

A comparative analysis of the airline studied in this research (non-US airline) and an airline previously studied by Wiegmann et al in 2003 (US-airline) using the same metric revealed that there is a considerable difference in safety cultures in those two airlines/organizations. The non-US airline has a culture that is characterized by a *Middle-of-the-road* approximation with tendency towards *Delegate-Safety-to-Others.* On the other hand the safety culture grid for the US-airline demonstrates a culture that values a *Collaborative* team environment but at the same time the safety culture is tending clearly towards administrative *Master Plan*. In this comparison it should be kept in mind that the

Wiegmann et al used the five-factor model but in the present study the four- factor model was applied, which presents a more thorough analysis of the factors and an improvement over the original model.

Survey results indicate that the overall safety culture at the study airline is generally positive on average and above the neutral point on all dimensions, though considerable variability exists in pilots' safety culture perceptions. All areas of the safety culture show room for improvement. The safety culture at this airline appears to be strongest in the areas of operational personnel (e.g. chief pilots and instructors) and weakest in the area of organizational commitment (e.g. going beyond compliance).

Particular weaknesses concern especially, with two areas. Firstly, pilots perceive management as too focused on making money than being safe and secondly, that it applies merely the regulatory minimums when it comes to issues of flight safety and nothing more. Once the management of an organization realizes that safety is financially rewarding and that the costs incurred have to be seen as investments with a positive return, the road to a full safety culture is open. Pilots also note they would like to be more actively involved in development and improvement of procedures and safety concerns, which they currently are not according to the survey results. Good safety cultures are characterized by good communication between management and the rest of the company. This not only enhances safety, but can elevate morale and in some cases, productivity. Having a definitive focus for improving communication can result in improved performance at all levels. The feedback/comments from the respondents can aid the management of the airline to effectively allocate resources to the safety issues in need of improvement.

The generalization of these findings is somewhat limited due to low response rate. In this study, as well as described by Wiegmann et al. (2003), only pilots and supervisory personnel were asked to complete the survey and therefore no conclusion can be reached regarding the state of safety culture among other groups of employees that are responsible for safety at the airline. Until this is accomplished, we have only partial information as to the overall safety culture at the airline. In spite of this we can conclude that the objectives of the research have been achieved and an appropriate study of flight operations safety culture at the airline has been conducted. Furthermore, we can conclude that the CASS is psychometrically appropriate to non-US operations. Further development and testing of this tool has been subsequently performed in both US and non-US cultures since this study was completed and preliminary results indicate acceptable reliability.

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