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### **37 The Relationship between the Implementation of Safety Management Systems and Attitudes towards unsafe Acts in Aviation**

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#### **Introduction**

The International Civil Aviation Organization (ICAO) is a United Nations (UN)-specialized agency in the field of civil aviation. Under Article 44 of the Convention on International Civil Aviation (The Chicago Convention), one of the aims and objectives of the Organization is to “insure the safe and orderly growth of international civil aviation throughout the world” (Chicago, 1944). The Convention is supported by eighteen annexes containing standards and recommended practices (SARPs). The annexes are amended regularly by ICAO. ICAO (2006) outlined the importance of maintaining international civil aviation safety within a rapidly expanding industry and within resource limitations of oversight authorities. The paper proposed that complementing the regulatory approach to the management of safety with a performance-based approach was essential. Performance-based approaches to the management of safety are best exemplified by safety management systems (SMS), and the maturity achieved by the SMS concept allows for its implementation on a global basis.

Within the paper the term safety management was said to convey the notion that the management of safety is a business process that must be considered at the same level and along the same lines as any other business process. Likewise the term system was said to convey the notion of an integrated set of processes aimed at managing safety that crosses departmental boundaries, thus addressing safety concerns from an integrated, broad perspective. ICAO then defined an SMS as “a systemic approach to the management of safety, that includes the necessary organizational structure, accountabilities, policies and procedures.” (ICAO 2006, para 2.4). ICAO requires that all member State Airports must implement a Safety Management System (SMS) as a means of ensuring safe operations and eliminating or reducing the likelihood of low frequency/high consequence incidents (ICAO, 2007).

Whilst the mechanics of what constitutes an SMS have been made clear, and the assertion that the SMS will contribute to safe operations, it is unclear what influence such a system has on the safety perceptions and safety thinking of employees at the organisation within which the SMS is implemented. Robson, Clarke, Cullen, Bielecky, Sevrin, Bigelow, Irvin, Culyer and Mahood (2007) found that in spite of the concept of an occupational health and safety management system (OHSMS) being common for over 20 years, there were no other systematic literature reviews of their efficacy, although some narrative reviews existed which did not provide the rigour necessary. Robson et al (2007) refined 27 identified total elements in reviewed literature into 16 primary elements of a model for OHSMS. They then used these elements to review literature reporting voluntary and mandatory OHSMS initiatives, and from these reports to determine the impact and effectiveness of OHSMS.

Robson et al's review (2007) found a relatively small quantity of published, peer-reviewed evidence involving OHSMS interventions, despite the fact that reviewers screened over 4800 studies drawn from eight databases representing diverse disciplines. Their review showed that the majority of studies reported mostly favourable results, with a few null findings, but no findings of negative effects. Offsetting this was their finding that all but one of the studies included in their final analysis had moderate methodological limitations. They suggested that the studies reviewed were seldom sufficiently rigorous to allow great confidence in the reported findings. They concluded that despite the generally positive results on the effectiveness of OHSMS interventions, the evidence they evaluated was insufficient to make recommendations either in favour of or against particular OHSMSs.

What is also not clear in the literature is how the implementation of SMS influence the attitudes of employees, and in particular their attitudes toward unsafe acts and hence influences safety culture. To this end the main purpose of this research project was to determine whether a relationship exists between implementation of an (SMS) and consequent attitudinal change towards unsafe acts within an international Airport that had not had any formal SMS. The hypothesis being tested sought to determine whether the implementation of an SMS into an international airport would result in an improvement in the measure of safety culture at that airport.

### **Safety Management System Implementation**

Sharjah Airport used the GCAA CAR Part X, and the ICAO Safety Management Manual (2<sup>nd</sup> Edition, 2009) Doc. 9859 as the basis of the SMS which includes the following components by way of summary:

1. Safety policy and objectives
2. Safety risk management
3. Safety assurance
4. Safety promotion
- 5.

### **Safety Culture Survey Construction**

A Safety Culture Survey was used to determine pre and post SMS intervention measures of employee attitude toward unsafe behaviours. The Safety Culture Survey was constructed by Dix and Bates (Research Supervisors), and was largely based on the UK Workplace Health and Safety culture survey. The questionnaire devised was presented as statements of opinion in which the participants were asked to response using a 5- point Likert-type scale, ranging from 1 (strongly agree) to 5 (strongly disagree). Demographic questions were included to identify participants' age, gender, current occupation, number of years that have been involved in their current position, and number of years that they have been involved in aviation.

The survey was expected to achieve a number of objectives. The first objective was to gain an overall picture of the safety culture at each organisation - how staff perceive safety or safety behaviour at the time of application within that organisation. The second objective was to use the survey results to establish a baseline of measures of attitudes toward unsafe behaviours, against which any reimplementation of the survey could identify the extent of changes in attitudes, (positive or negative), after initiating an SMS.

### **Survey Implementation**

Implementation of the Safety Culture Survey was conducted in two phases:

Phase One involved implementing the Survey at Sharjah and the second Airports in June 2008, prior to the implementation of the SMS at Sharjah Airport. At Sharjah, 265 surveys were distributed to staff. All 265 surveys were returned completed. At the second Airport, 34 surveys were distributed to a sample of staff, with all 34 surveys returned completed. The staff were all employees of the second Airport working in aerodrome operational areas.

Phase Two involved re-implementing the survey at both Airports 12 months after the initial survey implementation in June 2009 and after the implementation of the SMS at Sharjah International Airport. At Sharjah, 200 surveys were distributed to staff. All 200 surveys were returned completed. At the second Airport, 47 surveys were issued to a sample of staff, with all 47 returned completed. At the second Airport there were an increased number of staff surveyed, because of the change in employee numbers. At Sharjah, due to restructuring there had been a 'push' to outsource some of the operational functions. Therefore, this resulted in a reduced sampling size. The same participants were surveyed in both Phases, apart from those who dropped out in Phase Two.

### **Sample Size**

The total population surveyed was 299 in Phase One and 247 in Phase Two from both Sharjah and the second Airport. The response rate was identified as being the critical uncontrolled variable in this study. It was calculated that a proportionate sample would provide sufficient precision for the study (Cooper & Schindler, 2001). This assumed that from Phase One and Two 95% of the participants would respond definitively to the questionnaire, and that this result could be applied to the total population with accuracy.

### **Analysis of Results**

As the results of the Phase 1 survey (June 2008) were to be compared against the results of the follow-up survey (June 2009), the data from the questionnaires were subjected to inferential statistical analysis using multivariate analysis of variance (MANOVA). The MANOVA procedure permits one to complete analyses with multiple outcome variables. A significant multivariate outcome is consistent with systematic effects that extend across outcome variables as a group. This being the case, one can then with some confidence examine the significance of effects in relation to specific outcome variables. For a variety of reasons, this analytic tool appears to be appropriate for this study (Wiggins & Stevens, 1999).

## **Results**

This research study hypothesized that differing emphases in the focus on safety concerns at the two airports (Sharjah – a new interest; the second airport – no change in focus) should lead to differential shifts in safety concerns as expressed by systematic changes across the nine scale scores by occasion and by airport. A series of MANCOVAs were performed with scale scores as dependent variables (DVs) and with occasion and airport as independent variables (IVs). It seems likely that personal characteristics such as differences in the length of time worked at an airport or the number of courses undertaken might also influence the scale scores of interest indicated above. To control for the effect of these personal characteristics, they were entered into MANCOVAs as covariates.

Personal characteristic variables were on the basis of the absence or near absence of missing responses. For this reason, age in years and years in aviation were not included in the list of personal characteristic variables to be entered as covariates. All six covariates were transformed into dummy variables (0,1). An initial MANCOVA with occasion and airport as IVs and with the nine standard scale scores as DVs was

performed. The multivariate results were statistically significant for occasion, airport, and the interaction between these two IVs.

In order to examine the effect by airport more closely, the file was split by airport and a second MANCOVA performed to examine the effect of airport affiliation together with six personal characteristic variables entered as covariates. Initial inspection of the effect of covariates (Years in current position, years at airport, number of courses attended, recency of last course attended, amount of training [not satisfactory, satisfactory], examination by assignment [No, Yes]) indicated that the recency of the last course attended was not associated significantly with scale scores related to either Sharjah or the second Airport. So, this variable was omitted and a third MANCOVA performed.

The multivariate effects of occasion, and also of all five of the covariates were statistically significant in relation to the nine standard scale scores. In the case of Sharjah Airport, not only occasion but also all of the five personal characteristics entered as covariates had statistically significant univariate effects with one or more of the nine standard scale scores. The average score reported by participants at Sharjah Airport increased significantly from Phase 1 to 2 in relation to communication, safety rules, supportive environment, personal risk appreciation, work environment, and involvement. At the same time, the average score for personal priorities decreased significantly from Phase 1 to 2. The multivariate effects of occasion, and also of four of the five covariates were statistically non-significant in relation to the nine standard scale scores. Given the non-significant main effect for occasion, further analyses were not attempted.

A methodological issue that provides an alternative explanation for the relative strength of effects obtained at Sharjah Airport vs. the second Airport is the imbalance in the number of participants at those two sites. That is, whereas 465 participants completed these surveys at Sharjah airport, only 81 did so at the second Airport. Note that each of the outcome tables includes the power of that effect as a reminder of the effect of sample size on such outcomes. Nonetheless, regardless of the difference in sample size, the extreme difference in outcomes does support the hypothesis that an active safety program has significant effects across a range of measures. Based on the patterns observed, these effects were mostly positive except for the observed significant tendency across occasions for participants at Sharjah airport to be increasingly inclined to view safety rules and procedures as not entirely practical during an emergency.

### **Summary and Conclusion**

The hypothesis being tested for this research project sought to determine whether the implementation of an SMP into an international airport would result in an improvement in the measure of safety culture at that airport. Overall the Results of this research support the hypothesis that the introduction of an SMS will influence the attitude of employees. The average score reported by participants at Sharjah Airport increased significantly from Phase 1 to 2 in relation to safety rules, supportive environment, personal risk appreciation, work environment, and involvement. At the same time, there was no corresponding increase in attitude for employees at the second airport at the multivariate level or for any of the personal characteristic variables with the exception of years in current position.

A major limitation for the study is that any observed differences in the emphasis on safety are accompanied by systematic differences across a range of other variables, including the difference in the number of persons recruited for this study from the two airports (almost 90% from Sharjah Airport). The presence of such statistically significant differences in the composition of participants sampled from Sharjah vs. the

second Airport supports the conclusion that any statistically significant airport related differences could be explained not only by a differing emphasis on safety but also by age, years involved current position, years working for an airport, years involved aviation, number of courses attended, exam assignment, and last course attended.

However it seems clear from the results of this research that participants at Sharjah Airport experienced and expressed significant changes in levels of safety concern that extended across the nine scales more generally at the multivariate level and across six of the nine scales at the univariate level, and that this sense of changed attitude was not reported from participants at the second airport. That is, outcomes reported are consistent with the hypothesis that the introduction of an SMS at Sharjah airport has effected changes not observed at the second airport. Importantly, the second Airport here represents a baseline or control condition in which one would not expect such changes given the maturity of the safety program already implemented. The good news is that even though a number of personal characteristic variables also predict scores at Sharjah airport at statistically significant levels, the effect of occasion is significant. In order to further investigate the influence of safety management systems on employee attitudes toward and behaviour in unsafe acts, a number of recommendations have been identified.

1. Continue to measure attitudinal change of participants at Sharjah Airport toward unsafe acts as the SMS matures to determine if the changed attitudes observed in this research project are sustainable.
2. Continue to explore the relationship between the implementation of SMS and employee attitude toward unsafe acts by replicating this research project, but this time ensuring that comparable numbers of employees are surveyed in each organisation.
3. Explore the relationship between employee attitudes toward unsafe acts and employee behaviour in unsafe acts. Of interest is whether an increase in employee positive attitude to safe acts is accompanied by an increase in safe behaviour.
4. Undertake an evaluation of the key components of an SMS implementation to determine which are critical to its successful implementation.
5. There would be value in undertaking an evaluation of how organisations engage and maintain commitment to SMS goals and objectives.

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