# Exploring safety culture in the military aviation context

Anthea ASHFORD<sup>1</sup>, Elizabeth HELLIER<sup>2</sup>, Robert BRIDGER<sup>1</sup> and Andrew WEYMAN<sup>3</sup>

<sup>1</sup>Institute of Naval Medicine, UK <sup>2</sup>University of Plymouth, UK 3University of Bath, UK

**Abstract.** While understanding safety culture has become an integral part of many safety management systems, considerable debate on the concept remains. The contextual approach to exploring safety culture has gained interest, using both qualitative and quantitative methods. The current study explored the meaning of safety culture and its underlying components in a military aviation organization. Qualitative analysis yielded six overall themes; these were then developed into a quantitative survey and analyzed using components analysis to explore the underlying themes.

Keywords. Safety culture, military aviation

# 1. Introduction

### 1.1 Safety culture

Safety culture has rapidly become an integral part of safety management across industries including nuclear, oil and gas, railways, aviation and maritime (Reiman and Rollenhagen, 2014). However, like its parent concept organizational culture, the notion of safety culture is plagued by disagreements on definition, boundaries, method of measurement, efficacy of interventions and ultimately its theoretical underpinnings (Kim and Wang, 2009). The theoretical debate is not novel - functionalists argue that culture is something possessed by a group, driven by the strategy and structure of organizational goals (Glendon and Stanton, 2000). Examination of safety culture from a functional perspective generally involves quantification of presence and strength, considering differences between groups (Edwards et al., 2013) and then trying to align these with wider organizational goals. Interpretive approaches adopt a more organic view, seeing safety culture as emerging from social grouping that occurs throughout the organization (Glendon and Stanton, 2000). This then is said to generate a deeper understanding of the assumptions and shared beliefs of the group members. Whilst purists could argue the mutual exclusivity of these approaches, a pragmatic approach may be to acknowledge the contrasting strengths and limitations of each as complementary rather than irreconcilable (Guldenmund, 2010a; Edwards et al., 2013).

When exploring safety culture within an organisation, it is thought important that a contextual approach is taken, acknowledging the core task of an organisation which determines the objective and constraints within which employees operate (Reiman & Rollenhangen, 2011). This may furnish a more nuanced understanding of employee attitudes and behaviours toward safety in the workplace. The key aim for safety practitioners is to try and understand how people view safety and whether that is in line with the management direction for safety. Although organizations may not be able to change underlying assumptions, by shaping organizational processes they may be able to encourage behaviors seen to enhance safety (Guldenmund, 2010).

### 1.2 Military aviation

The relationship between the military context and safety culture is of particular interest as a willingness to take risks while maintaining a positive attitude toward safety are institutionally viewed as compatible and desirable (Borjesson et al., 2011). As Falconer (2006 p 1) notes "...the goals of the armed forces can only be achieved by balancing the safety of the system and it's operators with extreme and often unpredictable hazards". While aviation is acknowledged as a high-risk industry (O'Conner et al., 2011), military aviation activities have the added risk of operating in extreme environments, in challenging conditions and with rapidly changing objectives. However, the group cohesiveness and clan nature of military professionalism is also an interesting ground for exploring the nature of safety culture.

In the United Kingdom (UK), regulation and safety management of the safety of military aviation activities has undergone several changes since the loss of the Nimrod MR2 Aircraft VX230 in Afghanistan in 2006. These changes aimed to achieve a common approach to safety management across the three Services (Ministry of Defence, 2012) and have established safety culture as a key tenet of the process.

# 1.3 Aims

To try and progress the understanding of organizational safety culture, this research aimed to ground inquiry into military aviation safety culture initially in the experiences of employees; and to gain their insider perspective on how safety manifests itself in their daily work contexts. And then to distill these perspectives into a quantitative survey, to determine the generalisability of these findings on a larger, and more diverse population.

### 2. Methods

### 2.1 Study design

The study involved a multi-method approach, in two phases. The initial qualitative phase (Phase 1) involved an exploration of personnel perspectives of safety culture and drivers of risk taking / risk averse behavior. Phase 2 involved a quantitative (staff survey based) investigation of the underlying constructs through principle components analysis (PCA). The design of both phases is summarized below. Both were undertaken within ethical protocols approved by the Ministry of Defence Research Ethics Committee (MODREC).

### Phase 1

Twelve focus group discussions were held with opportunity samples of military aviation personnel (N=89), drawn mainly from aircrew (pilots and crew) and aircraft maintainer functional groups. The focus groups were audio recorded and transcribed verbatim.

### Phase 2

Using the themes and insight gained from Phase 1, a quantitative approach was used to consider the generalisability of the findings from Phase 1 on a wider sample. The method followed established organisation-level psychometric study practice (Zohar, 1980, Mearns et al., 2004). This process involved: (i) development of a large battery of items reflecting the insights gained in Phase 1 (ii) cognitive piloting of items, (iii) administration of items in the form of a questionnaire to a large sample of personnel, (iv) PCA to explore the factorial structure.

# 2.2 Data analysis

# Phase 1

The transcripts were explored using thematic analysis, a method well suited to identifying, analysing and reporting patterns in the data (Braun and Clarke, 2006). This analysis was done

using Nvivo 9 software. A sample of transcripts (N=3) were independently coded by two researchers, with inter-rater reliability tested using the Kappa statistic (Cohen, 1960) resulting in an acceptable (k=0.72) degree of concordance.

### Phase 2

PCA was chosen to analyse the questionnaire data from a large sample (N=556) to explore the underlying factor structure. The themes identified in Phase 1 were used as the basis for developing the initial pool of questionnaire items. After piloting the statements 79 items were kept for the main survey. Participants responded to these statements using a five point Likert scale (Strongly agree to strongly disagree) considering their current workplace. A varimax rotation was used, components with an eigenvalue of one or greater were considered for retention.

# 3. Results

### 3.1 Phase 1

The analysis resulted in the identification of seven nameable themes which are considered to be headline influences on workplace safety culture in this organization (See Table 1). Each theme contained several sub-themes but in this paper only the headline themes will be detailed.

Theme	Summary of theme		
Adherence to policy & procedures	This played a key role in how safety was perceived and implemented, apparently high levels of social legitimacy of procedures were inherent across participants. Barriers to compliance were identified in this theme e.g. bureaucracy and accountability featured as aspects.		
Pressure	The balance between realization of both safety and operational objectives was a highlight of this theme, with manpower resource being a key safety pressure.		
Management ownership of safety	Management was seen as integral to safety, as safety role models and engendering trust and confidence, particularly supervisors. Views on senior management were more limited.		
Individual & collective responsibility	A strong sense of personal responsibility for safety was evident, with high levels of camaraderie within groups. This theme also encompassed the high consequence of failure and responsibility for risk management.		
Communication	This theme covered two-way communication- reporting of safety incidents and feedback from this and the importance of just culture to encourage this communication. A possible subculture was identified between aircrew and maintenance engineers.		
Organizational commitment	This theme presented strongly amongst participants, who articulated a sense of shared value and purpose, and pride in the organization.		

### Table 1 Identified themes from Phase 1

### 3.2 Phase 2

The rich contextual information gained in Phase 1 was used as a basis for the quantitative exploration of underlying constructs of safety culture. Of the 79 items 8 were removed due

to high skew or kurtosis values, and 1 due to low correlation with any other items. The data was considered suitable for PCA (Kaiser-Meyer-Olkin = 0.959; Bartlett's test of Sphericity p<0.0001) After several iterative steps, the final PCA solution comprised six components, containing 53 items and accounting for 53% of the variance (see Table 2). The content of the items within each component were considered to inform the naming of the six constructs.

	Rotation Sums of Squared Loadings		
		% of	Cumulativ
Component	Total	Variance	e %
Management commitment & organizational learning	34.12	14.98	14.98
Normative behaviour & reporting	38.94	12.07	27.05
Training & experience	43.58	9.17	36.22
Process & bureaucracy	46.79	5.39	41.61
Manpower	49.61	5.26	46.87
Hazard identification & responsibility	52.12	5.25	52.12

Table 2 Rotated solution from PCA

Table 2 shows six factors that overlap somewhat with the qualitative findings of Table 1, as well as with findings from the wider safety culture literature.

### 4. Discussion and Conclusion

The study combined quantitative and qualitative methods to explore safety employee characterizations of safety culture in a military aviation organization. Initial thematic analysis of focus group discussions allowed contextualization and investigation of the most salient aspects of the work situation that were seen to affect and shape the safety culture.

Employees characterized their work environment as one in which a focus on safety was inherent in all aspects of the organization, predominately driven by a strong feeling of personal responsibility and awareness of the high consequences of failure. Policy and procedures were seen as an inherent aspect of the work, often derived from organizational learning practices. Management was seen as a key supporter and enabler of safety, particularly through supervision and provision of role model behavior. This was, however, juxtaposed with pressures that potentially impact safe behavior including: a lack of manpower, the requirement to complete a goal with fewer resources, time pressure, bureaucratic processes and variations in the application of a just culture. These discussions were almost unanimously underpinned by a strong undercurrent of commitment to the organization and its goals, along with good camaraderie among participants.

This qualitative analysis allowed an in-depth understanding of how personnel might characterize their work environments for safety, and provided a basis to develop a set of questionnaire items. Principle components analysis of these items (Phase 2) allowed further exploration of the underlying factor structure, to compare and contrast to findings from the initial phase of the study. Six components were identified; several supported the findings of Phase 1.

Management was still seen as a key enabler of safety but this component specifically comprised items related to organizational learning: management supporting a just culture, learning from safety evens, listening to staff and encouraging questioning. This is interpreted as management being perceived as more than simple top-down conduits of safety information, but as a key part of the two-way process of safety management in this organization. Example items include 'Managers here would rather know about safety issues than not know' and 'If a genuine error is made (resulting in an accident or near miss), management will always be supportive'.

Interestingly the component of 'Normative behaviour & reporting' contains items that overlap with several themes from Phase 1, those of 'communication', 'adherence to policy and procedures' and 'pressure'. This reflected behaviours that could be seen as norms e.g. '*Operational demands mean sometimes people have to take shortcuts*' and '*People here take shortcuts when they think there is little or no risk involved*' and that may be taken when pressures are high, and involve working around procedures. It is important to note that the mean scores for these items suggest that, on the whole, participants in this organization do not often witness these behaviors.

Training and experience was a component separately identified in Phase 2 which was a small sub-theme within '*Individual and collective responsibility*' of Phase 1, suggesting that it is of importance to military aviation personnel, partially independent to other components. Process and bureaucracy is a component not generally identified in safety culture studies but was highlighted in Phase 1 as a barrier to compliance with procedures e.g. '*It is too bureaucratic to report all safety concerns*'. This was supported by impressions (in Phase 1) of increasing policy and procedures which individuals struggled to stay on top of. This resounds with discussions by Power (2004) of secondary risk management where increased policy making can lead to unwieldy procedures for operators.

Despite being identified as a sub-component of 'Pressure' in Phase 1, manpower was a demonstrably independent component in Phase 2, possibly reflecting the shrinking manpower of UK Defence and increasing global expectations to maintain output while reducing headcount.

The final component of 'Hazard identification & responsibility' overlaps with findings of Phase 1's 'Management ownership of safety' and 'Individual & collective responsibility' e.g. '*Where I work hazards are appropriately assessed and controlled*'. This supports the idea that identifying and dealing with hazards may be an independent part of the safety culture picture for these professional military aviators. The theme of 'Organizational commitment' did not account for any variance within the model in Table 2 despite it being a salient theme identified in Phase 1. This may be because there is so little variability in opinion for these participants (everybody is proud of the work the origination does). It is likely that this theme is of wider application than just safety culture, and may be indicative of a more general organizational culture amongst military participants who are highly cohesive and identify strongly with their organization.

In conclusion, the qualitative investigation of safety culture among employees provided a grounded understanding of the salient aspects of the work setting that influenced safety. These insights were then tested for generalizability through established organisation-level psychometric study practice (Phase 2). The second phase supported several themes identified in Phase 1, but also provided extra insight into further orthogonal components and allowed exploration of the relationship between these. Future research will focus on the development of this safety climate measurement tool through: testing of the internal reliability, test-retest reliability and confirmed component structure. Once completed, the tool would benefit from validation, at which point several options exist. External validity could be considered by using the tool with other military populations to determine whether this could be generalized to other military contexts. Predictive validity of safety climate tools is often tested against safety performance behaviours (although only weak relationships with accidents have been shown) which in this context might be e.g. correct completion of procedural paperwork or hazard

#### reporting.

The organization currently considers safety culture in its safety management procedures and the current study contributes to this process. Consideration of demographic differences across the climate tool results will inform targeted consideration of requirements for improvement, which is important when considering resource restraints. Of particular interest to other organizations might be the juxtaposition between a clear belief in the importance of safety, yet a frustration about the surrounding bureaucracy. Resource constraints were also clearly identified as barriers to effective safe performance. In neither case do the individuals in the organization (at frontline/shop floor levels particularly) have much control. Both might resound with personnel in most large organizations. Positive individual employee attitudes toward safety must be supported by the organizational processes. It is suggested that the method employed in this study has applicability to other industries considering safety climate measurement where a combination of qualitative and quantitative methods should be seen as complementary.

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