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Development and Evaluation of Cabin Crew Expected Safety Behaviours

Peter Simpson, Graham Edkins, Christina Owens & Stuart Godley

Qantas Airways Ltd
Sydney, Australia

Abstract

Within the airline industry, expected safety behaviours are being increasingly used to assess or observe flight crew non-technical skills (CRM) performance. While safety and human factors programs are well established components of cabin crew training, airlines are yet to identify the non-technical skills required of cabin crew to successfully manage safety critical tasks and situations. In addition, there is a lack of data on how cabin crew deal with threats and avoid, recover and manage error. This paper describes a two-part research project being undertaken within Qantas Airways. Phase 1 involved the application of the Critical Decision Method protocol to identify successful decision making skills amongst experienced cabin crew. From a qualitative analysis of interviews with eighty Customer Service Managers (CSMs), expected safety behaviours were identified, and grouped under the following seven elements: situational awareness, information & resource management, operational understanding, passenger management, crew management, negotiation & influencing skills, and workplace safety. The use of these expected safety behaviours in training and performance planning is discussed. Phase 2 of the project involves the proposed implementation of a LOSA-type program within the Cabin Crew environment, utilising the expected safety behaviours developed in Phase 1. The applicability of LOSA for cabin operations as well as the logistical and practical challenges of planning and implementing normal operations monitoring for cabin crew is discussed. In addition, an outline of the expected benefits of this research to air operators and the wider aviation industry is provided.

Introduction

In recent years, human factors training programs have begun to develop more rigorous criteria for training and evaluation. Behavioural competencies are replacing the traditional approach to CRM, which has focused on attitude change (eg. van Amermaete & Krujisen, 1998). Behavioural marker systems are becoming increasingly accepted as a legitimate means of measuring individual and team performance in a range of high reliability contexts, most notably aviation (Flin & Martin, 2001), nuclear power (O'Connor, Flin & O'Dea, 2001) and medicine (Fletcher, McGeorge, Flin, Glavin & Maran, 2002).

Expected Safety Behaviours (ESBs) are generally thought of as observable, non-technical behaviours that contribute to effective or ineffective performance within a specific work environment. They are usually structured into several categories, and the categories are comprised of the actual behavioural markers or indicators. A behavioural marker should describe a specific, observable behaviour, not an attitude or personality trait, and demonstrate a causal relationship to performance outcome. Klampfer et al. (2001) suggest the following uses for ESBs:

- To enable performance measurement for training and assessment;
- To highlight positive examples of performance; and
- To build performance databases to identify norms and prioritise training needs.

In contrast to the initial development of CRM style programs, characterised by their wide variety, different assumptions, different training methods, and a lack of common content, the recent growth of behavioural human factors training has been accompanied by a shift toward standardised programs. In the aviation industry, three research groups have led the push for behavioural markers systems.

In Europe, the Joint Aviation Authority has produced the NOTECHS (Non-Technical Skills) framework, an amalgamation of existing airline behavioural markers systems, to measure non-technical skills (van Avermaete & Krujisen, 1998). The NOTECHS project was motivated by Joint Aviation Requirements (JAR) which mandate the training and assessment of pilot's CRM skills. The NOTECHS system includes five principles, which are intended to provide objective assessment. The first requirement is that only observable behaviour is assessed. Secondly, for behaviour to be rated unacceptable, it is a requirement that there be a threat to flight safety. The third requirement is that unacceptable behaviour must be repeated during a check to determine if there is a substantive problem. Fourthly, each behaviour must be rated as either acceptable or unacceptable. Finally, an explanation is required for each unacceptable rating. These five basic principles of NOTECHS will also apply to any future inflight CRM assessment at Qantas.

In the United States, the University of Texas has developed the Line Operations Safety Audit (LOSA) program to provide a new platform to collect data. LOSA utilises trained observers to collect data about flight crew behaviour on normal flights under non-jeopardy conditions. Observers record potential threats to safety and how the flight crew detect, recover and manage threats and errors (Helmreich, Klinect, & Wilhelm, in press). Qantas has implemented LOSA for pilots.

The Gottlieb Daimler and Karl Benz Foundation launched the GIHRE (Group Interaction in High Risk Environments) aviation project to validate the existing behavioural markers for

CRM assessment under conditions of high workload. Comparisons between the NOTECHS and LOSA behavioural markers will identify which behavioural markers differentiate best between effective and ineffective crews under high workload (Klampfer et al., 2001).

In addition to the three projects described above, a number of airlines have developed their own behavioural marker systems for training and assessing flight crew skills (see Flin & Martin, 2001, for a review). For example, Qantas assesses CRM expected behaviours as part of their Advanced Proficiency Training (APT) project.

However, methodological guidelines for the development of behavioural markers are lacking. For example, the NOTECHS system has been developed based on an amalgamation of existing marker systems amongst various European carriers, rather than utilising any formal cognitive task analysis process. A number of airlines have developed their own behavioural markers, using a variety of informal methods and techniques. It appears that studies using established, valid and reliable processes such as cognitive task analysis or critical decision techniques are required (eg., Hoffman, Crandall, & Shadbolt, 1998).

Furthermore, there does not appear to be any published research into the development of behavioural markers for cabin crew, despite CRM training being mandated in many countries since the early 1990's. Numerous accident and investigation reports reinforce the need for cabin crew to take appropriate action to deal with situations involving in-flight fire, ill or disruptive passengers, or passing on critical information to the flight crew. The handling of such emergencies calls for knowledge, skills and abilities quite different from those associated with normal service duties.

While the duties and functions assigned to cabin crew in the interests of passenger safety are well established across the aviation industry, there is no consensus on which skills are needed for effective cabin crew CRM or how to train CRM behaviours (ICAO, 2002). There are a number of benefits for establishing behavioural marker systems for cabin crew, including the ability for air operators to more easily identify risks to the operation in order to target cabin crew training effectively.

A behavioural marker system for cabin crew is also on the regulatory agenda in Australia. Unlike other countries such as the United States and in Europe, human factors training and assessment has not been mandatory for Australian air carriers. Recently, the Civil Aviation Safety Authority (CASA) released a proposal (CASR 121A) which details a plan for regulating human factors training for flight and cabin crew, based on a competency-based framework. This includes the identification of competency standards and behavioural markers, the development of evaluation methodologies for training feedback and the integration of technical and non-technical training. Therefore, the development of a behavioural marker system for Qantas cabin crew training is expected to not only meet this requirement but lead the wider industry towards this type of program. A proven, practical methodology to identify and assess cabin crew behaviours would be beneficial to the wider industry in the form of guidance material.

Therefore, the aims of this study were:

1. To identify specific behaviours that are central to proficient cabin crew safety performance (ESBs); and
2. To determine the best method for the assessment of identified safety behaviours (ESBs) during normal line operations.

Method

Participants

The participants for the critical decision interviews consisted of eighty Customer Service Managers (CSMs). CSMs are responsible for the supervision of cabin crew and the management of cabin services (known as Pursers or Cabin Supervisors in some airlines). The CSMs were a mixture of short haul (54%) and long haul (46%) from various bases across Australia. They had spent an average of 7.5 years operating as a CSM (range = 1-25yrs, sd = 6.2yrs), and their mean age was 42 years (sd = 7.0yrs).

The participants were recruited via posters placed around crew lounges and sign-on areas. The criteria for participation were that the person must be a CSM, and that they could discuss, in detail, a recent (within 18 months) safety-related event that was challenging. CSMs were paid for the ground duty time they spent being interviewed (usually 1.5 – 2 hours).

The interviews were conducted by six interviewers, who were also CSMs. Although their main role was interviewing, these six team members also helped with data analysis and development of the safety behaviours, and acted as expert practitioners for the project. CSMs were used as interviewers because they are subject matter experts, with a large domain knowledge of cabin safety issues

Design

The variables of home base location (Sydney, Melbourne, Brisbane, Perth) and operation type (short or long haul) were controlled to ensure the CSMs proportionally represented the Qantas operation.

The interview process was based on Klein's Critical Decision Method (CDM) (Klein, Calderwood & McGregor, 1989), which is a variant of Flanagan's (1954) Critical Incident Technique. Flanagan states that the Critical Incident Technique can be applied for a variety of situations and uses in aviation, including:

- Measuring typical performance - developing critical requirements for evaluating the typical safety behaviour of an operator;
- Measuring proficiency - providing a basis for evaluating proficiency in a check and training situation; and
- Measuring training effectiveness - providing an indication of the effectiveness of training programs.

These are three areas that the Expected Safety Behaviour project may eventually cover at Qantas.

The CDM is a retrospective interview strategy that applies a set of cognitive probes to non-routine incidents that requires expert (CSM) judgement or decision making (Klein et al., 1989). A semi-structured interview format is used to probe different aspects of the decision process.

The CDM is effective in revealing experts' knowledge, especially tacit knowledge, reasoning and decision strategies. Compared to other methods of knowledge elicitation, the CDM yields more information, including a wider variety of specific cognitive details, more information about underlying causal linkages among core subjects, and the revelation of tacit knowledge (Hoffman, Shadbolt, Burton & Klein, 1995). The reliability of the procedure is based on the idea that experts have clear memories of salient or unusual safety-related incidents (Hoffman et al., 1995). This method of knowledge elicitation has been used successfully in naturalistic environments such as fire fighting (Taynor, Klein & Thordsen, 1987), para-medicine, nursing (Crandall & Gretchell-Reiter, 1993), helicopter flying (Thordsen, Klein & Wolf, 1992), and military command and control (Kaempf, Wolf, Thordsen & Klein, 1992). It is now established as a valid and reliable method of cognitive task analysis and knowledge elicitation (Hoffman et al., 1998; Taynor, Crandall & Wiggins, 1987).

Procedure - Critical Decision Method (CDM)

The first step in Phase 1 was the CDM interviewing. The procedure for employing CDM is well documented (Klein et al., 1989; Hoffman et al., 1998), but the basic steps used in the interviewing process included:

1. Incident selection - CSMs select a recent, non-routine incident that was challenging;
2. The interviewer obtains an unstructured recall of the event;
3. Both participant and the interviewer establishes the sequence of decision events and constructs a time line;
4. Decision point identification –the interviewer identifies specific decisions that were made;
5. Decision point probing – probing/questioning techniques are used to identify effective decisions and resultant behaviours (see Table 1 for examples of the probes);
6. Hypotheticals and 'what ifs ?' The interviewer chooses several decision points, and asks hypothetical questions based upon different event outcomes (eg., what would you do if the Captain didn't take your request seriously?). These queries serve to identify potential errors, alternative decision-action paths, and expert/novice differences (Hoffman et al., 1998); and
7. Standard case study - CSMs are provided with a standard case study[1] and repeat steps three to six as if they were the CSM onboard that aircraft.

Probe Type	Probe content
Cues	What were you seeing, hearing, smelling?
Knowledge	What info did you use in decision making and how was it obtained?
Analogues	Were you reminded of any previous experience?
Standard scenarios	Does this case reflect a typical scenario or a scenario you were trained in?
Goals	What were your specific goals and objectives at the time?
Options	What other courses of action were considered or were available?
Mental models	Did you imagine the possible consequences of your action?
Experience	What specific training, experience ort knowledge was necessary?

[1] The standard case study was a real Qantas incident on-board a B737. It involved smoke and fumes in the cabin, with many CRM issues and problems.

Decision making	Was there any time pressure? How long did it take to make the decision?
Aiding	What training, knowledge or experience could have helped you?
Errors	What mistakes are common at this point? How might a novice act?

Table 1. A Sample of CDM Probe Questions (Adapted from Hoffman et al., 1998)

Participants were informed that the interviews were anonymous, and the only identifying information collected was age, years operating as CSM, home base, and operation type (long/short haul). Interviews were conducted in a quiet office and tape-recorded (if permission was granted). Most interviews lasted for 1.5 – 2 hours; requiring at least one hour for the first critical incident, and half to one hour for the repeated case-study incident. Verbatim transcripts were made from the tapes.

Procedure - Development of Expected Safety Behaviours (ESBs)

The second step in Phase 1 of the study involved the coding of the interviews and development of the ESBs. The procedure consisted of a number of stages (stages 1, 2, 3 and 4 have been completed, stages 4, 5 and 6 will be completed in 2003):

1. Initial coding of the transcripts to develop behavioural markers.
2. Improve code structure and markers with feedback from cabin crew subject matter experts (the six CSMs within the project team).
3. Analysis of behavioural markers by general CSM population, including written feedback requested from the entire CSM population to gain general comment and feedback on the list of ESBs, and brief interviews (20 mins) with random CSMs (n=20) to attain more detailed responses. Both methods included rating the importance of each behavioural marker to the safe, efficient conduct of the flight.
4. Produce a master list of ESBs.
5. Measure inter-rater reliability (kappa) and then code remainder of interviews.
6. Attain a frequency count of behavioural marker elements/behaviours occurring in each incident.
7. Construct a ‘training focus matrix’ (frequency ESB occurring *vs* importance ESB) for the training of expected safety behaviours (see Fig. 1). This is based upon the results from steps 3 and 6 and allows objective prioritisation of training.

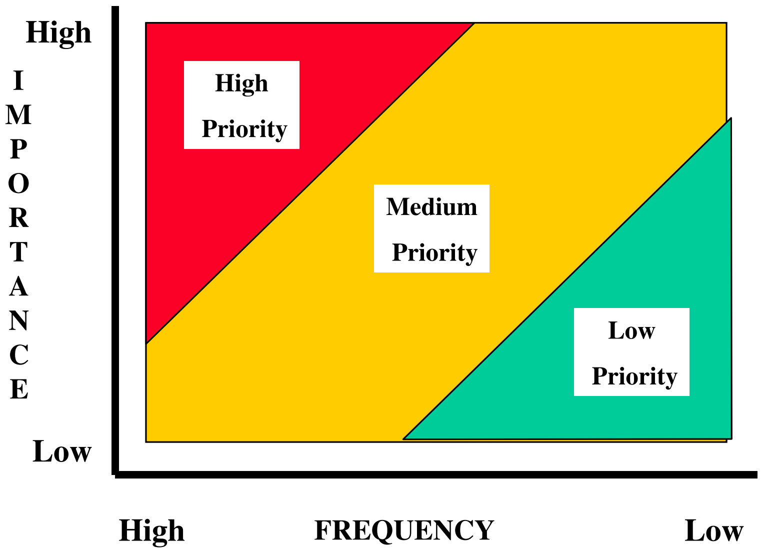

Figure 1. Expected Safety Behaviour Training Focus Matrix.

Results and Discussion

Critical Decision Method

Eighty interviews based on the Critical Decision Method were used to attain the initial list of ESBs. Six interviews could not be used due to failed or poor quality tape recording, unsuitability of the incident, or lack of decision probing. The majority of critical incidents recalled by CSMs could be categorised under seven headings (see Fig 2). Almost half of the incidents were related to disruptive or drunk passengers (20%), in-flight medical emergencies (17%), or security/terrorism threats (12%). The large number of security/terrorism threats has only occurred since Sept 11^{th}. It is interesting to note that so many safety issues revolve around aircraft door and slide issues (10%). Aircraft technical issues (8%) refer to problems such as aborted take-offs, engine problems, and cockpit and cabin equipment malfunctions.

The break down of all Qantas reported cabin safety incidents for the 13 month period Jan 2001 to Feb 2002 is proportionally similar to those of this study. For example, the main reported incidents were passenger behaviour (24%), medical (16%), door/slide issues (5%), smoke/fumes (18%), and turbulence (1%) (Qantas, 2002).

The initial coding of interviews revealed seven ESB categories, each with multiple elements. These are listed in Table 2.

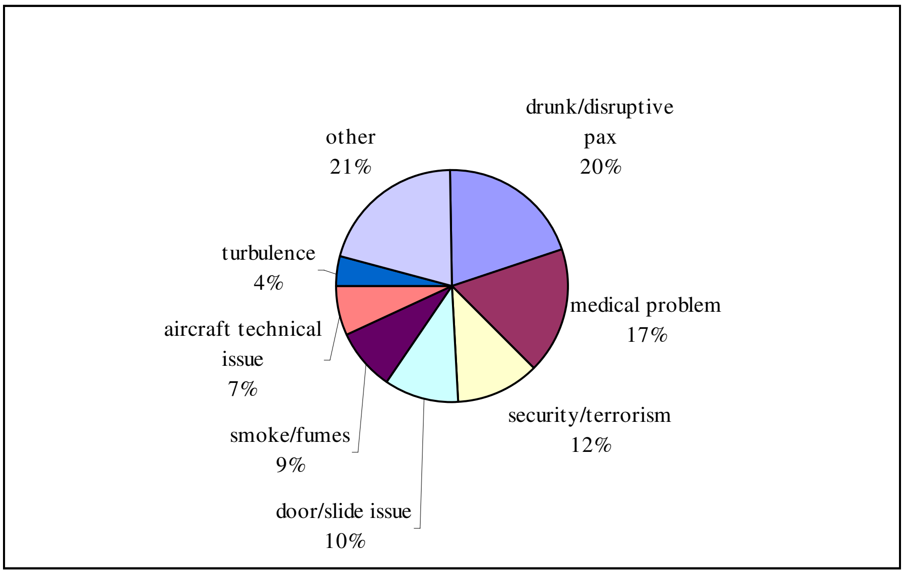

Figure 2. Type of Critical Incidents Recalled in the CSM Interviews

Development of Expected Safety Behaviours (ESBs)

Once the initial list of ESBs was drafted, it was distributed (via internal mail) to all CSMs for feedback and comment. Further, twenty interviews (20 mins each) were conducted with random CSMs in crew lounges during their pre-flight sign-on period. The interviews provided more detailed information and feedback than the mailed feedback survey.

Feedback and comments from the CSMs have reinforced the validity of the ESBs, and have allowed the production of a final 'master list' of behaviours (see Table 2). Typical comments from these interviews included "this list looks like my (job) position description", and "now management may understand what I do". CSMs also believed that such behaviours could be trained, and would make CRM/HF assessment possible.

Feedback was also required on the relative importance of the ESB categories. CSMs were asked to rank the seven categories in order of importance to safe, efficient conduct of their job and the flight. The ranking process is based upon the median scores, rather than the mean to avoid the problem of outlying rankings. The seven categories are displayed in the resultant rank order in Table 2 and Figure 3. The four highest ranked categories (situation awareness, workplace safety, passenger management, crew management) were clearly defined in order, however the last three categories (operational understanding, negotiation & influencing skills, information & resource management) were not, and could have appeared in any order (see Fig. 3). The general ranking process is still in progress (only 40 feedback forms have been returned), and rankings may change slightly as further feedback forms are returned. The ranking of importance is to be used in the "ESB Training Priority Matrix" (see Fig. 1). The matrix can be completed when all the interviews are coded and the frequency of behaviours is determined.

Expected Safety Behaviour Category	Expected Safety Behaviour Element / Behaviour
Situation Awareness	• Demonstrates awareness of flight phase • Considers political & cultural context • Considers time constraint • Recognises higher safety goals and priorities • Anticipates decision consequences • Develops contingency plans
Passenger Management	• Assesses passengers (boarding or in-flight) • Monitors potentially threatening pax behaviour/condition • Acts decisively to modify passenger behaviours/condition • Considers passengers well-being • Presents a calm, controlled image to passengers • Diffuses situation in a non-confronting manner • Minimises cabin disruption
Workplace Safety	• proactively manages OH&S situations • reactively manages OH&S situations • follows-up OH&S situations • communicates OH &S importance • displays role model OH&S behaviours
Crew Management	• Assesses crew • Provides onboard coaching and training to modify behaviour • Considers crew well-being • Considers impact of non-routine events on crew performance • Allows and provides crew debrief
Operational Understanding	• Demonstrates Basic Aeronautical Knowledge (BAK) • Understands authority/duty of CSM • Understands authority/duty of others
Negotiation & Influencing skills	• Consults with others to develop a common strategy • Manages upwards – identifies problem • Manages upwards - expresses concern • Manages upwards - provides options • Manages upwards - uses emergency language
Information & Resource Management	• Identifies & utilises all resources • Gathers information • Confirms common understanding of information • Critically analyses information • Provides timely feedback to those who need to know • Prioritises tasks

Table 2. Expected Safety Behaviour Categories and (preliminary) Elements

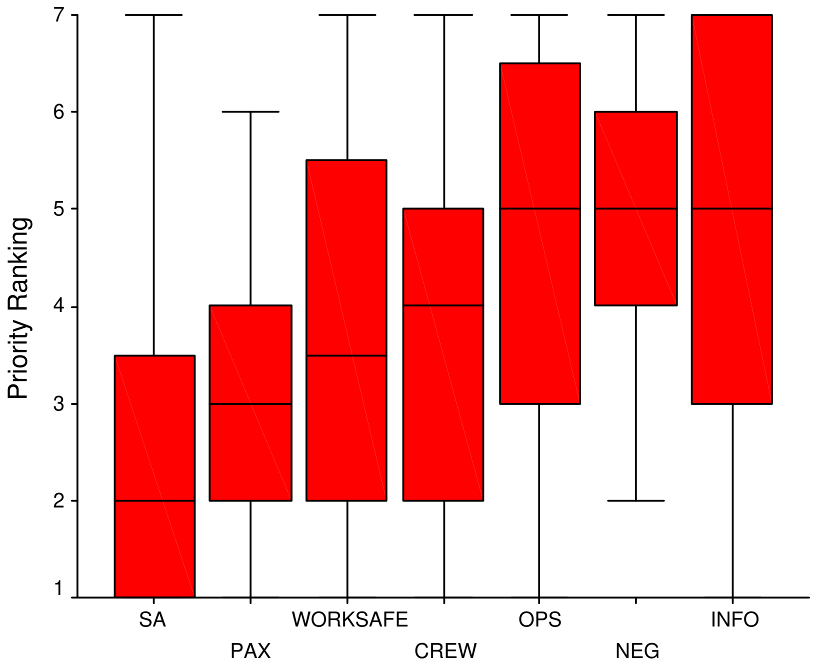

Figure 3. Boxplot showing median and interquartile ranges for the seven ESB Categories (Black line indicates median rank. Box indicates inter-quartile range. Error bars indicate entire ranking range.)

Future Phases - ***Phase1***

The main product to be developed from the cabin crew expected safety behaviours project is a master list of ESBs (as per Table 2). These are to be used in training of cabin crew, and for the evaluation of human factors and CRM skills.

Figure 4 is a representation of how such ESBs may look when they have been transferred to a Qantas in-flight observation form. This is based on a version currently in use with pilots. The back of such a form would contain the full list of behaviours/elements (as listed in Table 2) for reference.

The interview transcripts are currently being used as training aids for human factors and CRM training. There are now eighty Qantas-specific incidents that can be used as case studies and examples for cabin crew training and education. Because the incidents focus on the cognitive aspects of the situation, they are an excellent training aid for teaching expert skills and behaviours to novices. Further, most incidents have positive outcomes, and Qantas training is refocussing largely on positive examples (what went right) for crew training, rather than negative examples (what went wrong), as has traditionally occurred in aviation CRM training.

CSM:		
Cabin Crew	Sector:	Date:

		Ineffective	Marginal	Effective	Highly effective	COMMENTS
1	**Situation awareness**					
2	**Workplace Safety**					
3	**Passenger management**					
4	**Crew management**					
5	**Operational understanding**					
6	**Negotiation & influencing skills**					
7	**Information & resource management**					

Ineffective	**Marginal**	**Effective**	**Highly Effective**
This is a behaviour which: • May contribute to an uncorrected error • Immediate improvement is required in this area	This is a behaviour which: • May impair crew from completing a task, but is unlikely to contribute to uncorrected error • Crew members will benefit from further training or self-improvement	This is a behaviour which: • Facilitated the effective completion tasks free of significant error • Demonstrates an example of CRM that crew members should achieve in line operations	This is a behaviour which: • Facilitated the completion of tasks with more efficiency than is normally required • Demonstrates an example of CRM that all crew members should strive to achieve

Figure 4. Mock-up of Cabin Crew Expected Safety Behaviour Evaluation Form

The ESBs could also be used in recruitment of cabin crew. Potential staff could be recruited against the actual safety behaviours and skills required by Qantas cabin crew, rather than against generic industry requirements, ensuring that only the most suitable applicants are selected.

Future Phases - Phase 2

In the longer term the ESBs can be used in a similar manner to the way in which they are used for cockpit crew – the evaluation of CRM and non-technical skills in training. However, the greatest challenge is moving the evaluation and observation of safety behaviours out of the training environment and into normal line operations, in the form of a cabin crew LOSA program. There are many issues and problems to overcome before in-flight cabin observations can take place. Such problems include:

- Cabin environment is not as contained as a cockpit.
- Double deck aircraft.
- All information goes through CSM.

- Observers are more obtrusive in cabin.
- Errors tend to be less consequential in the cabin.
- Impact on customers & service.
- Multiple crew to observe.
- Less external threats to inflight safety in the cabin.

Many of these logistical issues are not relevant to the cockpit, where check and training for technical skills has been an accepted practice for decades. Further, CRM and non-technical skills audit and evaluation is gaining acceptance in the cockpit, and a cockpit LOSA program is running at Qantas. As yet, no airline has committed to a LOSA-style program for cabin crew, and to our knowledge, the proposed Qantas project is the first attempt to apply this program within the cabin environment.

Summary and Conclusion

Expected safety behaviours or non-technical skills are being increasingly used to assess or observe flight crew CRM performance. Safety and human factors programs are well established components of cabin crew training, but the non-technical skills required to successfully manage safety critical tasks and situations have not yet been identified. This paper described a two-part research project being undertaken within Qantas to address this lack. Stage 1 involved the application of the Critical Decision Method protocol to identify successful decision making skills and expected safety behaviours amongst experienced cabin crew (CSMs). Seven main categories were developed. These expected safety behaviours can also be used to improve the future recruitment of cabin crew, and the eighty interviews can be used as training aids for cabin crew CRM and safety training. Stage 2 of the project (which is yet to be completed) may involve the implementation of a LOSA-style program within the cabin crew environment, utilising the expected safety behaviours developed in Stage 1. The applicability of LOSA for cabin crew operations as well as the logistical and practical challenges of planning and implementing normal operations monitoring for cabin crew are still major issues to be resolved.

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