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Line Operations Safety Audit (LOSA) for the Management of Safety in Single-Pilot Operations (LOSA:SP) in Australia and New Zealand

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Abstract

This paper investigates the feasibility, effectiveness and benefits of implementing a single pilot operations variant of the multi-crew Line Operations Safety Audit (LOSA) methodology, in the management of safety in single pilot operations. LOSA is designed to provide a proactive snapshot of system safety and flight crew performance as a way of preventing incidents and accidents (Klinect, 2006). The data indicators underlying this effort are based on a conceptual framework known as Threat and Error Management (TEM) (Helmreich et al, 2001).

A recent spate of incidents and accidents involving single pilot operations both in Australia and New Zealand have given emphasis to the vulnerability of this group to safety issues and confirms statistics that show this category of aviation has a higher incidence of accidents and incidents than in other sectors of the industry (CASA, 2009, NZCAA, 2009). By adapting LOSA to single pilot operations (LOSA:SP) the framework/methodology could provide a proactive method of diagnosing operational safety performance strengths and weaknesses under normal operations leading to the identification of additional training requirements and improved procedures without relying on adverse safety events for such information.

Introduction

Most of aviation's understanding of safety performance is based on data concerning adverse safety events, such as those collected from incident reporting and accident investigations (Maurino, 2001). This can be seen as reactive measures of safety as they are dependant on negative flight outcomes (Reason, 1997). Accident and incidents are problematic in assessing accident causation and have been unreliable in prevention of future incidents.

The Line Operations Safety Audit is a proactive measure that serves to fill this gap with its collection of TEM data in normal flight operations. It can be seen as a proactive safety measure that complements existing data sources such as line evaluations, quick access recorders, voluntary incident reports and accident investigations.

LOSA is a formal process that requires expert and highly trained observers to occupy the jumpseat during regularly scheduled flights in order to collect safety related data on environmental conditions, operational complexity and flight crew performance. *'It provides a diagnostic snapshot of strengths and weaknesses that an airline can use to bolster its safety margins and prevent their degradation.'* (Helmreich, 2006). LOSA uses a targeted observation instrument based on the TEM framework.

LOSA has been developed and refined since 1996 with major international airlines becoming involved forming a collaborative partnership with The University of Texas Human Factors Research Project (UTHFRP) (Klinect, 2006). Captain Don Gunther (2002), Manager of Human Factors Training at Continental Airlines hailed LOSA as a success, saying that Continental Airlines provided the 'proof of concept' for LOSA that transformed it from a research tool to an industry-ready safety tool.

In 2001, LOSA became a central focus of the Flight Safety and Human Factors Programme (Klinect et al, 2003). ICAO has also introduced a standard making TEM training mandatory for airline flight crews engaged in international operations (Merritt and Klinect, 2006), which must be delivered during initial as

well as recurrent training. TEM based LOSA is now considered to be best practice for normal operations monitoring and aviation safety by ICAO, the Federal Aviation Authority (FAA) and the Civil Aviation Authority (CAA).

More recently, regional airlines operating turboprop aircraft have seen the potential benefits of a Line Operations Safety Audit with a plan by the LOSA collaborative to bring regional airlines into the LOSA sphere (Rosenkrans, 2007). Air New Zealand operated Mt Cook Airlines and Australia's Regional Express (REX) were amongst the world's first regional operators to implement LOSA

The Guild of Air Pilots and Air Navigators (GAPAN) conducted a series of TEM courses in 2008/9 for pilots involved in low capacity public transport and single - pilot operations. The ATSB's safety report (AR-2006-156(2)) looked at the threats and errors that participants of these courses considered were the five most common in their industry.

This paper considers those smaller (single - pilot) operations and the actual threats and errors that occur in flights.

Research Overview

The LOSA methodology provides the tools to record threats to safety that the pilot might encounter and errors that are made by pilots and the response to those errors. An example of a threat would be adverse weather conditions or an aircraft system malfunction. LOSA identifies the occurrence of these threats and facilitates the analysis of the actions taken by pilots to manage them Thomas (2003). Errors are seen as 'an unavoidable and ubiquitous aspect of normal operation' (Thomas, 2003) but it is an important aspect of pilot performance in how those errors are recognised, trapped and mitigated .

By using the threat and error management (TEM) conceptual framework, LOSA focuses simultaneously on the operating environment and the humans working in that environment. As the TEM taxonomy can also quantify specifics and effectiveness of performance, the results are also highly diagnostic (Merritt and Klinec, 2006).

Traditionally the smaller operators have experienced a higher accident rate than larger carriers, both in Australia, New Zealand and worldwide (ATSB, 2007). Analysis of occurrence figures show that smaller companies with single pilot operation are experiencing an increase in accident statistics (CASA, 2009, CAA 2009). Despite efforts in this area to increase safety with traditional methods (training, seminars, education, regulation, inspection etc), there appears to have been less research in this segment of the industry when compared with that conducted for and by major carriers and more recently regional carriers.

All LOSAs to date have been conducted in multi crew operations where the LOSA observer occupies a jumpseat on the flight deck. However, it is suggested that, by applying the LOSA concept to single pilot operations, with a carefully designed research methodology pertaining to this type of operation (LOSA:SP), such methodology could provide an opportunity to understand the operational context, pilot processes and outcomes during single pilot routine flights. If successful, in a similar manner to LOSA, it will give an insight into normal operations, whilst diagnosing strengths and weaknesses of pilots without relying on accidents or incidents to gain that information. Helmreich in Flight Safety Australia (2006) compares CRM in both multi-crew operations and single-pilot operations, identifying several points where CRM can be adapted for single pilots. Introducing the LOSA methodology to improve threat and error management in single pilot operation could therefore be achievable and successful in reducing incidents and accidents. Thus safety could be enhanced in a field where other methods have failed.

Objectives

According to Allison McDonald et al (2006), the results of a "LOSA – Like" trial in passenger train operations, where in – cab observations were made on single driver operations, could ultimately highlight future directions for training and awareness and make potential improvements to organisational systems and processes.

By applying LOSA to single pilot operations (LOSA:SP) and using the University of Texas data analysis system, threats and errors could be decreased, awareness enhanced and training and education improved, based on the results of the assessments.

Methodology

At the heart of LOSA are non-jeopardy observations, without which flight crew would be unwilling to accept the presence of an observer in their domain. As LOSA has progressed, pilots and managers are seeing the safety benefits of the system and as Airlines conduct future LOSA assessments the willingness to contribute has increased.

This study has considered various methods to collect data in single pilot operations, both where an observer was possible but also in situations where an observer was not possible or not appropriate. Adaptations have been made to the LOSA methodology in order to facilitate the comprehensive and unique differences applicable to the single pilot situation. This has included, for example, revisions to some of the error categories. However, LOSA data indicators based on the established TEM framework were retained due to their proven nature. ICAO specifies ten characteristics that define LOSA (ICAO, 2002). These will be replicated and adapted for single pilot operations.

As in LOSA, LOSA:SP will collect data on pilot demographics, threat occurrence and management; error occurrence and management and CRM effectiveness through TEM - based behavioural markers.

An initial study was carried out with the aid of the Australian Aviation Academy (AAA) at Archerfield Airport, Brisbane which conducts all flight training for Griffith University. For this a panel of experts was convened which included a member of the LOSA collaborative, the AAA Chief Flying Instructor (CFI), the researcher and a pilot representative.

A two fold study was designed with a traditional observation methodology compared with data collected by the use of cameras. This approach was adopted both to test the efficacy of the cockpit cameras and to compare the results from both as to accuracy and comparability. An observer was designated to fly for two exploratory sectors in a Cessna 172 whilst a CPL student was on “solo” cross country practice and completed a paper based LOSA observation report. A panel of experts examined and analysed the data on retrieval.

At the same time, a feasibility study was carried out to ascertain the placing of the cameras and the accuracy of the data in a flight training school aircraft following a student and instructor doing circuits. On the basis of this, the camera and equipment were modified until the technical crew were satisfied with the results. Further flights were then filmed and a panel of experts set up to categorise the threats and errors that were observed through these test flights.

A mannequin with cameras attached to the body (designed by David Venish of Stepthru videos) was explored as possibly being a less intrusive use of cameras. However, it was found that the cameras could only be mounted on the framework of the mannequin which actually increased their visibility and intrusiveness and created a potential safety threat within the cockpit.

Ultimately it was found that the installation of cameras in cockpits to record both the movement of the pilot’s limbs and head, the instruments and the outside forward view, together with an audible recording device and a GPS to track the aircraft movements was the best method. Daniel Brosnan from National Jet (Cobham) and Roly Hibbert from Virgin Blue were most helpful with technical advice.

Once initial observations and methodology were ascertained, the team entered into discussions with the Royal Flying Doctor Service (RFDS) who are in the interesting position of being single - pilot operations but “multi-crew”. RFDS pilots have emergency medical and operational issues to consider that anecdotally might have the potential to impact on decision making. Initial discussions with one division of RFDS have been greeted enthusiastically in terms of the potential safety benefits and the LOSA:SP team are currently working in conjunction with the management team to set up a LOSA within this division. It is hope that data can be obtained by use of camera technology, supplemented by an observer on board for a number of flights to observe the non-technical or crew interaction aspects of flights. It is emphasised that one of the prime defining characteristics of LOSA is the de-identification and confidentiality of all data.

Concerns

Concerns on observer reliability, establishing trust with those being observed, and an accurate coding scheme are similar within most field observation methodologies.. Possibly the most important data quality issue is one of observation reactivity, which occurs when individuals may alter their normal behaviours because of an observer’s (or camera’s) presence in the cockpit.

Also, it is important to observe pilots who are both willing to participate in the study and who are representative of the group. Amongst the considerations stated by pilots included balancing a desire to participate in a study that may result in a safer operation versus potential monetary loss (loss of paid flight hours). Also, for single pilot commercial passenger flight operations, the addition of an 'observer' would reduce the 'paying capacity' of the spare seats.

Ethical clearance was obtained prior to commencement of the flights observations. This was considered to be an integral part of establishing the feasibility of the study. The LOSA defining principles emphasising complete de-identification of individuals together with strict confidentiality and "no jeopardy" provisions (ICAO, 2002) assisted greatly.

Discussion

Whilst mechanisms such as incident reports and confidential reporting systems, together with line checks are commonplace in organisations attempting to improve their safety performance, these may not provide sufficient information for an organisation to unmask hidden latent errors in the system (Thomas 2003) LOSA acts as a pro-active evaluation tool and is potentially more powerful with respect to safety measures.

Ashleigh Merritt, one of the original data analysts from early LOSA's comments that TEM based LOSAs continue to provide valuable diagnostic information about an airline's strengths and vulnerabilities and sees LOSA as best practice for normal operations monitoring and safety. (Merritt and Klinec, 2006) Furthermore LOSA is now recognised and recommended to all airlines as best practice :

"LOSA is proposed as a critical organisational strategy aimed at developing countermeasures to operational errors. It is an organisational tool used to identify threats to aviation safety, minimise the risks such threats may generate and implement measures to manage human error in organisational contexts." (ICAO, 2002)

As LOSA developed as a powerful pro-active safety tool, the methodology was adapted to other areas with equally positive results. Air Traffic Control (Normal Operations Safety Survey – NOSS (Fellow, 2005)), the military, (Mission Operations Safety Audits – MOSA (Burdekin, 2003)), and Queensland Rail (Confidential Observations of Rail Safety – CORS (McDonald et al, 2006)) all completed successful "LOSA – Like" audit activities.

Now that LOSA has been established as a successful and innovative tool, the adaptation to single pilot operations was a logical next step. The data retrieved by placing cameras in the cockpit has been found to be comparable to that taken by an observer, so subsequent filming was deemed to be a true picture of the operation. Feedback from pilots was supportive and helpful.

An ATSB report provided a basic survey on perceived attitudes of threats and errors from single – pilot participants in TEM training (ATSB, 2009) whilst, with the aid of mounted cameras, a comparison will be made as to the reality of these views.

Results to date will be presented at the AAvPA conference in Sydney in April 2010 and on-going studies discussed.

It is proposed that LOSA:SP model will provide a feedback mechanism to allow pilots to manage threats and errors more successfully in the future and thereby increase their safety margins. Ultimately it is proposed that the data would form part of a LOSA:SP archive which could be compared with the existing LOSA Archive and used to inform training and regulatory interventions within the aviation industry, leading to safer outcomes.

The study will conclude with the desire to roll the practice out to other flying operations leading to better safety outcomes.

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