Adaptation of Line Operations Safety Audit (LOSA) to single pilot operations (LOSA:SP)

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Abstract
This paper examines Line Operations Safety Audit (LOSA), and explores the feasibility as well as implications of adapting it from a multi-crew setting to 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).

Incidents and accidents involving single pilot operations have increased in New Zealand over the past decade. Statistics show that this category has a higher incidence of accidents and incidents than in other sectors of the industry (CAA , 2006). 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 leading to the identification of additional training requirements 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.

To identify risk factors illustrated in normal operations would give valuable information in recognising potential risky behaviour. It would then be possible to develop tools from these normal practices to manage those adverse behaviours. A line check[1] would be considered such a proactive measure but line checks are normally limited in identifying safety issues (Klinect, 2006).

Line Operation Safety Audit (LOSA) is another proactive measure that serves to fill this gap with its collection of threat and error management (TEM) data in normal flight operations and 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 ride 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 it's safety margins and prevent their degradation.' (*Helmreich, 2006). LOSA uses a targeted observation instrument based on the TEM framework.

Helmreich's (ICAO 2002) Threat and Error Management model (TEM) works on the recognition that even the most competent and skilful crew will make errors during the course of their flight. In a typical

[1] Often required by government regulators, line checks are cockpit evaluations of pilots during regularly scheduled flights to assess proficiency.

flying day the pilots have to deal with a number of *threats* that include errors made by those outside their control, such as Air Traffic Control (ATC), flight attendants, maintenance workers etc, weather vagaries, congested airspace or anything that has the potential to compromise flight safety. The effectiveness of the crew's ability to deal with these threats relies on them detecting them. However, threats, unlike errors, can be anticipated, such as a thunderstorm that can be seen on weather radar or other aircraft notified to them.

On the other hand an error is a '*crew action or inaction that leads to a deviation from crew or organizational intentions or expectations'* (Klinect, 2006). Flight crew errors vary from minor deviations, such as not doing a checklist to something more complex, like forgetting to set the flaps on take off. Some errors are quickly detected and resolved, leading to inconsequential outcomes, whilst others go undetected or are mismanaged. An error's effect on safety depends on it being detected and managed. Unfortunately not all errors are managed well leading to an '*undesired aircraft state' (UAS).*
Regardless of cause or severity, errors can lead to undesired aircraft states and, ultimately, accidents.

By using the threat and error management (TEM) conceptual framework, LOSA focuses simultaneously on the operating environment and the humans working in that environment. Merritt and Klinect (2006) explain that "*because the framework captures performance in its 'natural' or normal operating context, the resulting description is realistic, dynamic and holistic"* As the TEM taxonomy can also quantify specifics and effectiveness of performance, the results are also highly diagnostic (Merritt and Klinect, 2006).

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.

The Continental LOSA success story was quickly recognised by the International Civil Aviation Organisation (ICAO) with the result that 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 best practice for normal operations monitoring and aviation safety by ICAO, the Federal Aviation Authority (FAA) and the Civil Aviation Authority (CAA).

Recently LOSA was adapted for and used successfully with regional airlines. In January 2007, the regional airlines in Australia expressed a desire to implement LOSA into a regionally operating airline - Regional Express (REX) . The REX report provided a diagnostic snapshot of normal flying operations (ATSB Transport Safety Report, 2007). With the analysis of the data and the feedback to the airline the REX management introduced several programmes to reduce the observed errors, which they hope will be embedded in the REX flight operations culture.

Traditionally the smaller operators have experienced a higher accident rate than larger carriers, both in New Zealand and worldwide. Over the past few years, New Zealand Civil Aviation Authority statistics report an overall improvement in incidents and accidents in the part 125 and 121 groups (larger airlines). However, analysis of occurrence figures show that smaller companies with single pilot operation (ie: Small aeroplanes [135] Agricultural operations [137], Adventure and Sport airlines [135]) are experiencing an increase in accident statistics (CAA 2006). 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.

It is, thus, suggested that by applying the LOSA concept to single pilot operations, but designing a unique 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. 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. Further, a recent CAA Advisory Circular (2006) uses data from the NASA Aviation Safety Reporting System (ASRS) to

identify the most common errors in single pilot IFR operations. These have similarities with threats and errors seen in the LOSA data from multi crew operators. Equally, 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 of error management into single pilot operation could therefore be achievable and successful in reducing errors leading to incidents and accidents. Thus safety could be enhanced in a field where other methods have failed.

Objectives:
By applying LOSA to single pilot operations (LOSA:SP) and using the UTexas data analysis system, threats and errors could be decreased, awareness enhanced and, with training and education, New Zealand's small operators could have a safer operation. Furthermore, by implementing LOSA:SP, an increase in efficiency and, therefore, productivity, would be achievable. This study, thus, proposes to achieve the following research objectives:

- Design and develop a LOSA framework for single pilot operations and align it with the LOSA archive data for analysis and interpretation.
- Create a tool for translating and adapting the LOSA programme to single pilot operations (LOSA:SP)
- Conduct a research into single pilot operations using LOSA:SP

This dissertation seeks to support that:

- It will be possible to create a tool that is applicable to single pilot operations
- From this tool, LOSA:SP will be able to produce qualitative and quantitative data to apply to single pilot operations throughout New Zealand that will mark a change in pilots' behaviours
- An adapted LOSA for single pilot operations can be successfully applied with a subsequent positive effect on accident and incident rates.

Methods:
This study presents a field observation method of an adapted Line Operations Safety Audit (LOSA) designed for single pilot operations to provide a proactive snapshot of system safety and pilot performance under normal operational flights (LOSA:SP). The data indicators are based on a conceptual framework known as Threat and Error Management (TEM) designed by the University of Texas Human Factors Research Group. Using this framework and the rationale underlying LOSA, this study adapts the LOSA methodology to promote its use for single pilot operations. With the advice from pilots within this sector of the industry, the author will design a model of data indicators for audit and analysis of pilot procedures and practices during normal operations.

Previous field work and observational data has led to ten characteristics that define LOSA. These will be replicated and adapted for single pilot operations:

- Jump seat observations of flights
- Voluntary pilot participation
- Anonymous, confidential and non-punitive data collection
- Joint management/union sponsorship
- Secure data collection repository
- Trusted and trained observers
- Systematic observation instrument
- Data verification roundtables
- Data derived targets for enhancement
- Feedback of results to pilots

LOSA uses a targeted observation instrument based on the TEM framework. This is a custom piece of software called the LOSA Data Collection Tool (property of the LOSA Collaborative). The LOSA observation form will be adjusted for single pilot LOSA. The benefits to using a custom software application include better data security, and data accuracy. The software also allows for response-determined guidance for observers and covers variability issues. The challenge will be adapting the framework for single pilot operations which could be achieved with the guidance of experts.

LOSA:SP Data will be divided into (1) demographic, (2) narrative, (3) crew resource management (CRM) behavioural markers, and (4) threat and error management measures.

A three stage approach, according to LOSA guidelines, will be used for data analysis

- Stage 1 – LOSA Indices and Organisational Profiles
- Stage 2 – Drill Down Analyses
- Stage 3 – Targets for Enhancement

Concerns to discuss

There are several concerns which may arise when conducting field observations. These include data reliability, establishing trust with those being observed, and an accurate coding scheme. Possibly the most important data quality issue is one of observation reactivity, which occurs when pilots alter their normal behaviours because of an observer's presence in the cockpit.

The recruitment of participants may be problematic. Different systems will be explored to determine which is likely to identify controls who are both willing to participate and who are representative of a comparable but unexposed population. For other single pilot operations consideration needs to be given to monetary loss versus a willingness to participate in a study that may result in a safer operation. For single pilot passenger air operations, the addition of an 'observer' would reduce the 'paying capacity' of their spare seats.

It would be necessary to explore each of the potential sources in terms of practicality and potential to produce a sample which is unbiased and appropriate to the study question.

This study is likely to generate a number of issues which will be of interest to an ethical committee, notably in respect of the involvement of participants. There would be a requirement to submit all study tools, as well as details of the processes involved. As such this is considered to be an integral part of establishing the feasibility of the study. Ethical clearance will be obtained prior to commencement of that part of the study.

Envisaged outcomes:

The model will provide a feedback mechanism to allow pilots to manage threats successfully in the future and increase their safety margins. The study will conclude with the desire to roll the practice out to other flying operations and to eventually form policy within New Zealand. Ultimately it would form part of the LOSA archive and be used to expand its methodology to other operations within the aviation industry for a safer industry.

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