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Line Operations Safety Audit 2014

LINE OPERATIONS SAFETY AUDIT

FINAL REPORT | 2014

Calm Air

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EXECUTIVE SUMMARY

Calm Air International LP conducted a Line Operations Safety Audit (LOSA) during the summer and fall of 2014. LOSA is a proactive safety effort which places trained and calibrated observers in cockpit jumpseats during normal flying operations to capture safety-targeted data about how Flight Crews manage the complexities that occur during their flights.

A Steering Committee made up of Calm Air management and Air Line Pilots Association (ALPA) representatives oversaw the project throughout its entirety, which began in April 2014 with the first Steering Committee meeting and completed in May 2015 with the publication of this report.

Volunteer Observers were selected from line pilot ranks and were trained and calibrated for their duties with support from a third party. A data collection tool was used to capture threat and error management (TEM) variables, along with flight narratives. A sample of flights was identified in order to capture the range of destinations, environments and aircraft types operated by the airline. The decision to allow a LOSA Observer into the flight deck was at the discretion of the Captain – all data was captured voluntarily and logged in a secure online database.

A total of 83 flight sectors were observed during the observation period, capturing 184 threats, 248 errors and 23 undesired aircraft states. Observes also conducted a brief questionnaire with flight crews about their thoughts related to specific aspects of the operation.

Table 1: LOSA TEM Summary

	Total Count	Mean (83 Sectors)	Standard Deviation
Threats	184	2.22	1.601
Errors	248	2.99	2.516
UAS	23	0.28	0.502

Trends in the data identified opportunities for improvement with visual approach briefings and other standard operating procedure (SOP) ambiguities as well as vulnerabilities in checklist and briefing practices. Intentional noncompliance was noted in areas commonly identified in industry LOSAs. Unstable approaches were logged at a rate consistent with industry averages, through no go-arounds were initiated as a result of an unstable approach (all were flown to a landing). Opportunities to improve working relationships with other organizational departments were identified, the System Operations Coordination Centre (SOCC) and Maintenance in particular.

The LOSA, though a logistically challenging effort, was seen to be an investment in Flight Operations - a proactive diagnostic safety tool to identify strengths and weaknesses within the operation. Many Pilots expressed support for the LOSA process, along with their anticipation and expectation that findings will lead to improvement and progress. A list of high-level recommendations is offered based on LOSA findings as a guide for future action.

ACKNOWLEGEMENTS

The pursuit of safety and operational excellence is much more easily discussed than acted upon. Taking a 'big airline' safety assurance tool from an idea to the material in this report took nearly 12 months and the time, energy and trust of a dedicated group of professionals.

I would like to thank Vice President, Operations Craig Hoffman and ALPA MEC Chairman Captain Dan Cowan for their organizational support and personal confidence in the LOSA team to deliver something meaningful to the organization.

Logistically, the project could not have operated without the coordination and support of Niky Cherneski, Dayna McKenzie, and Cindy Power in Crew Scheduling, augmented by Flight Operations Coordinators and Flight Dispatchers who provided day-of support.

The LOSA Steering Committee made up of Captain Rob Astwood (Director of Flight Operations), Captain Bill Stock (Chief Pilot), Captain Michael Rawlings (ALPA) and First Officer Stephen Bryce (ALPA) played an integral role in overseeing the project from beginning to end, and representing the perspectives of the stakeholders.

I'm incredibly proud to have worked with the line pilots who formed the observer group whose commitment to safety and professionalism is found in the diligence and attention to detail that informs this report. They were ambassadors of the program to their peers, and their reputations within the organization gave the LOSA the credibility it required to be successful.

First Officer Stephen Bryce
First Officer Stephen Carpenter
First Officer Dana Chepil
First Officer Matthew Kornelsen
First Officer Joel Lautenschlager
Captain Jarrett Sass
Captain Tanice Steiner

Finally, I would like to thank the line pilots of Calm Air for their commitment to their work, for the pride they take in the operation, and their willingness to share their flight decks in an effort to improve aviation safety.

Ryan Mitchell
First Officer
LOSA Project Manager

GLOSSARY

A/C	Aircraft
ACM	Air Cycle Machine, often referred to as an ‘ACM Pack’. Used for air conditioning.
ADU	Advisory Display Unit (ATR)
AGL	Above Ground Level
ALPA	Air Line Pilots Association
APM	Aircraft Performance Monitor; ATR system that monitors for performance degradation (ice accumulation)
APU	Auxiliary Power Unit
ASL	Above Sea Level
ATC	Air Traffic Control
ATIS	Automated Terminal Information Service
CAP	Canada Air Pilot
CARs	Canadian Aviation Regulations
CARS	Community Aerodrome Radio Station
CofG	Centre of Gravity
CRFI	Canadian Runway Friction Index
CRM	Crew Resource Management
CSA	Customer Service Agent
FAA	Federal Aviation Administration
FL	Flight Level
FMC	Flight Management Computer
FMC/FMGC	Flight Management Computer/Flight Management Guidance Computer (LOSA coding)
FMS	Flight Management System
FSS	Flight Service Station
GPU	Ground Power Unit
HDG	Heading (Heading Mode – Flight Director)
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
GPWS	Ground Proximity Warning System
Master Caution	Visual and Aural Alert to Crew; requires immediate attention but delayed action
Master Warning	Visual and Aural Alert to Crew; required immediate attention and immediate action
MCP	Mode Control Panel
MCP/FCU	Mode Control Panel/Flight Control Unit (LOSA coding)
NAV	Navigation (Navigation Mode – Flight Director)
NDB	Non-Directional Beacon
NM	Nautical Mile
NOTOC	Notification to Captain; designated document for informing crew of Dangerous Goods carried onboard.
OFP	Operational Flight Plan

PAPI	Precision Approach Path Indicator
PF	Pilot Flying
PNF	Pilot Not Flying
QRH	Quick Reference Handbook
RNAV	Area Navigation; often referred to in context of GPS-based navigation
SID	Standard Instrument Departure Procedure
SOP	Standard Operating Procedure
TCAS	Traffic Collision Avoidance System
TEM	Threat and Error Management
TOD	Top of Descent
VMC	Visual Meteorological Conditions

INTRODUCTION

LINE OPERATIONS SAFETY AUDIT (LOSA)

This report details the process and findings related to a Line Operations Safety Audit (LOSA) conducted at Calm Air during the summer and fall of 2014.

Traditionally, improvements in aviation safety have been the result of a reactive approach. The lessons learned from aircraft accident data have contributed to changes in regulations, technology, training and standard operating procedures, though at great cost. A limitation of the accident investigation is that it focuses on failure; we have to wait for an accident to occur, and then we can learn about how the crew handled the situation. What we do not learn from the accident though is how other crews have *successfully* managed a similar situation (ICAO, 2002).

Among the contemporary tools of aviation safety management that includes safety reporting and flight data monitoring (FDM) programs is the Line Operations Safety Audit (LOSA). The Human Factors Research Project at the University of Texas received FAA funding to develop LOSA in the early 1990s as a research effort to assess the transfer of Crew Resource Management (CRM) training from the classroom to the flight line (ICAO, 2002). LOSA places expert observers in flight deck jumpseats on routine line flight and uses the Threat and Error Management (TEM) model as a framework to collect and categorize crew performance data. This data can be used proactively to provide "a diagnostic snapshot of organizational performance [and also provide] a data-driven mechanism for measuring change (Klinect, Murray, Merritt, & Helmreich, 2003, p.2) that has the potential to impact nearly all departments in the airline by helping to:

- Identify threats in the airline's operating environment
- Identify threats in the airline's operating operations
- Assess the degree of transference of training to the line
- Check the quality and usability of procedures;
- Identify design problems in the human-machine interface
- Understand pilots' shortcuts and workarounds;
- Assess safety margins;
- Provide a baseline for organizational change; and
- Provide a rationale for the allocation of resources. (FAA, 2006, p.3)

A useful analogy for understanding the premise of LOSA is offered by the original developers:

> *"In the most general of terms, LOSA is similar to getting your cholesterol checked during a routine examination. The test, usually performed as a preventive measure, provides evidence of risk on having a heart attack or other serious health event. The results themselves do not provide a solution but can prompt a person to make healthier lifestyle choices. A person might also choose to do nothing and carry on as normal. Either way, the person learned something and is responsible for change. LOSA is the same. It provides a diagnostic snapshot of safety performance. It uses cockpit observations collected in normal operations to provide a profile of safety strengths and weaknesses. Similarly, the onus is on the airline to respond to the data and make change if necessary, in order to prevent an incident or accident."* (Klinect et al., 2003, p.2)

While LOSA may be more widely associated as a safety tool used by larger airlines such as Continental Airlines, Alaska Airlines, Cathay Pacific Airways, and Air Canada, its application has been successfully demonstrated in a regional airline setting (Eames-Brown, 2007). The original developers of LOSA identify 10 key operating characteristics of which, if employed, make it a tool that can be applied in most flight operations.

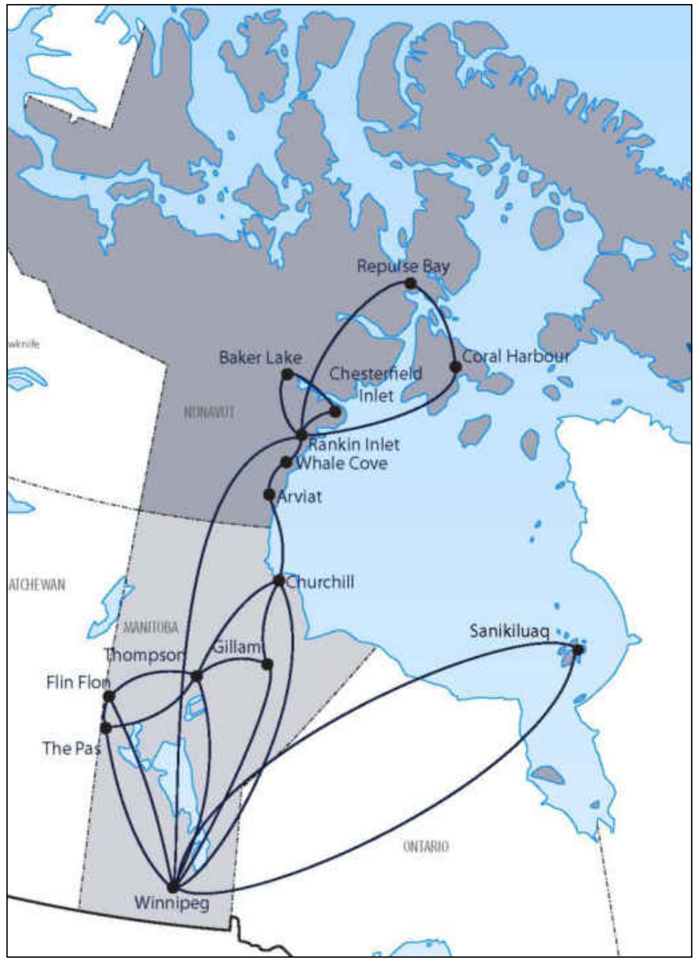
Discussion about conducting a LOSA at Calm Air began in mid-2013 as a tool to help collect meaningful operational safety data within the company's Safety Management System. To this point, the system had relied heavily on employee-submitted incident/hazard reports and proactive suggestions for improvement to assess organizational safety performance – these sources are valuable and essential, though they have limitations.

LOSA was seen as an opportunity to document and assess the defences and vulnerabilities of the airline through the experience of the flight crews. By conducting the process in a methodical and disciplined way, the outcome was seen as a valid data set of typical Calm Air flights that were representative of daily flight operations, which had credibility with both airline management and line pilots alike, and from which data-driven improvements could be made.

CALM AIR INTERNATIONAL LP

Calm Air is an independent regional airline that primarily serves the communities of northern Manitoba and the Kivalliq region of Nunavut. The company operates ATR42, ATR72, D328JET and Hawker HS748 aircraft in accordance with Canadian Aviation Regulations (CARs) Subpart 705 operations and has main bases in Winnipeg, MB and Thompson, MB, employing nearly 500 people. Calm Air had been owned and operated by its founders until 2009 when it was acquired by the Exchange Income Corporation. The parent company also owns several other Canadian air operators.

Figure A: Calm Air System Map



The airline conducts passenger operations as well as all-cargo freighter flights. Many aircraft in the ATR 42/72 fleet can be set to a 'combi' configuration to carry large amounts of cargo on scheduled passenger flights.

Freighter operations are normally staged out of Thompson or Churchill, MB where the company maintains warehouse facilities. ATR freighter aircraft can also be configured to carry bulk fuel in an integral tank system to re-supply remote communities.

A breakdown of the Calm Air fleet at the time of the LOSA is found below. Since being acquired by the Exchange Income Corporation, the flight operation has undergone a fleet renewal program that has seen the retirement of the Saab 340 fleet and all but one of the HS748 fleet and their replacement with ATR42/72 and Dornier 328JET aircraft.

With the exception of the HS748, all aircraft are equipped with flight management systems (FMS); the ATR42/72 use the Universal UNS-1K or UNS-1Lw and the D328JET fleet use the Honeywell FMZ series. At the time of the LOSA, only the D328JET fleet was authorized to conduct non-precision RNAV approach procedures.

Pilot Group

At the time of the LOSA, there were 90 pilots listed on the Pilot Seniority List, including 4 Management Pilots (V.P. Operation, Director, Flight Operations, Chief Pilot and Assistant Chief Pilot). The pilot group is represented by the Air Line Pilots Association (ALPA).

Table 2: Calm Air Fleet

Aircraft Type	No. in Fleet	In Service Since
ATR42	7	2007
ATR72	4	2010
D328JET	2	2012
HS748	1	1981
Total	*15*	-

Generally speaking, new-hire pilots come to the organization from Air Taxi (CAR 703) and (Commuter (CAR 704) flight operations. Pilots conduct initial and annual flight training in full flight simulators (ATR42/72 and D328JET), including Line Oriented Flight Training (LOFT). Annually, they also conduct two days of annual aircraft type training and two days of annual company training in the classroom including Crew Resource Management (CRM), supplemented with online learning.

While the organization sees flight crew turnover at along the natural rate in the industry, nearly 70% of line pilots had at least 5 years of service at the time of the LOSA. Internal research conducted in 2013 showed that the average age of a Calm Air pilot was 36 years old (SD=8.07) and that the average length of service with the company was 6.9 years (SD=4.73) (Mitchell, 2013).

Table 3: Pilot Aircraft Qualification and Workload (2014)

Aircraft Qualification	No. of Pilots	Average Hours Flown/Year (2014)	Average Days Worked (2014)
ATR42/72	65	635.9	178.4
D328JET	17	592.2	176.3
HS748	4	611.6	183.3
MGMT	4	105.8	-
Total	*90*	-	-

Flight Attendants are assigned to duty as crewmembers on passenger-carrying flights. Cabin crew complement for the D328JET, the ATR42, and the ATR72 (when in combi configuration) is one; two Flight Attendants are assigned to ATR72 flights when configured to full passenger configuration.

Flight Operations are conducted under a Type 'B' co-authority operational control system. Flight Dispatch is conducted from the System Operations Coordination Centre in Winnipeg, and is staffed whenever flight operations are being conducted.

Figure B: Calm Air Fleet Images

ATR42

ATR72

DORNIER 328JET

HAWKER SIDDELY HS748

LOSA METHODOLOGY

THE CALM AIR LOSA

The decision to move forward with the LOSA was made collaboratively in March, 2014 in a meeting between members Calm Air flight operations management and pilot association leadership. Both groups agreed with the value of the project and a five-person LOSA Steering Committee was formed which included two members of flight operations management (Director, Flight Operations and Chief Pilot), two line pilots nominated by ALPA (One Captain, one First Officer) and a project manager.

LOSA Steering Committee

The Steering Committee met to lay out the scope and timeline of the project, communicate LOSA to the organization (see Appendix B for communications sent to flight crews), identify solutions to expected challenges, and assemble a group of volunteer observers. Line pilots were invited in June to volunteer to participate as observers by forwarding their name to one of the ALPA representatives on the Steering Committee. Observers were selected by the Steering Committee; the committee first made a list of attributes that they felt were important in credible and capable observer group, and then the ALPA representative shared the list of names. In order to minimize bias and enhance credibility, management pilots would be excluded from conducting observations and use of check/training pilots would be minimized if possible. Unanimous agreement within the group was achieved and nine observers were selected.

Observer Training and Calibration

Many airlines contract out certain aspects of their LOSA while others conduct all aspects internally. Calm Air chose to conduct the LOSA internally with the exception of Observer training, which was conducted in July by Dr. Robert Baron of The Aviation Consulting Group. The four-day course covered all aspects of a LOSA with particular emphasis on Crew Resource Management (CRM), Threat and Error Management (TEM), data collection and calibration. A data collection instrument was finalized at this time (see Appendix A).

Dataset

Observations began the first week of August with the expectation of a two-month observation period and a goal of 80 unique observations as a sample of flying throughout the Calm Air network (aircraft type and route). While a larger sample size would have been desirable, this number was accepted as a compromise between what was required for a reasonable dataset and the resources that could be allocated to the project (observers were all active Calm Air line pilots).

A subscription to an off-site, LOSA-specific database was purchased for data submission. Observers were issued hard-copy worksheets for note taking in the cockpit as well as Microsoft Surface tablets to enter the data electronically to the online database.

Observation Flight Assignment

The assignment of observation flights was semi-randomized. A list of desired routes was identified, along with a breakdown of sectors by aircraft type which was proportional to the number of hours flown annually by each type. Observers bid specific days in their schedule as a part of their normal bidding process (~4 days per month) and were then assigned sectors to observe on those days by the Project Manager that would reflect normal operations within the organization (i.e.; arctic operations, freighter operations, etc.) and were not limited to the type of aircraft that they normally flew. The observation schedule was not made known to the line crews; the Observer would report for duty at the same time as the operating crew and approach the Captain about conducting a LOSA observation. Flight crews were aware that LOSA was entirely voluntary and that there were no repercussions if they elected not to participate. If a Captain decided to refuse an observation for any reason, they would communicate it back in confidence to the Project Manager, who would then ensure that future planned observation sectors would not target the same Captain. Due to factors that included weather-related flight cancellations, illness, and recall to flying duties, the observation period was extended into early October in order to meet the sample size goal.

Data Verification Roundtables

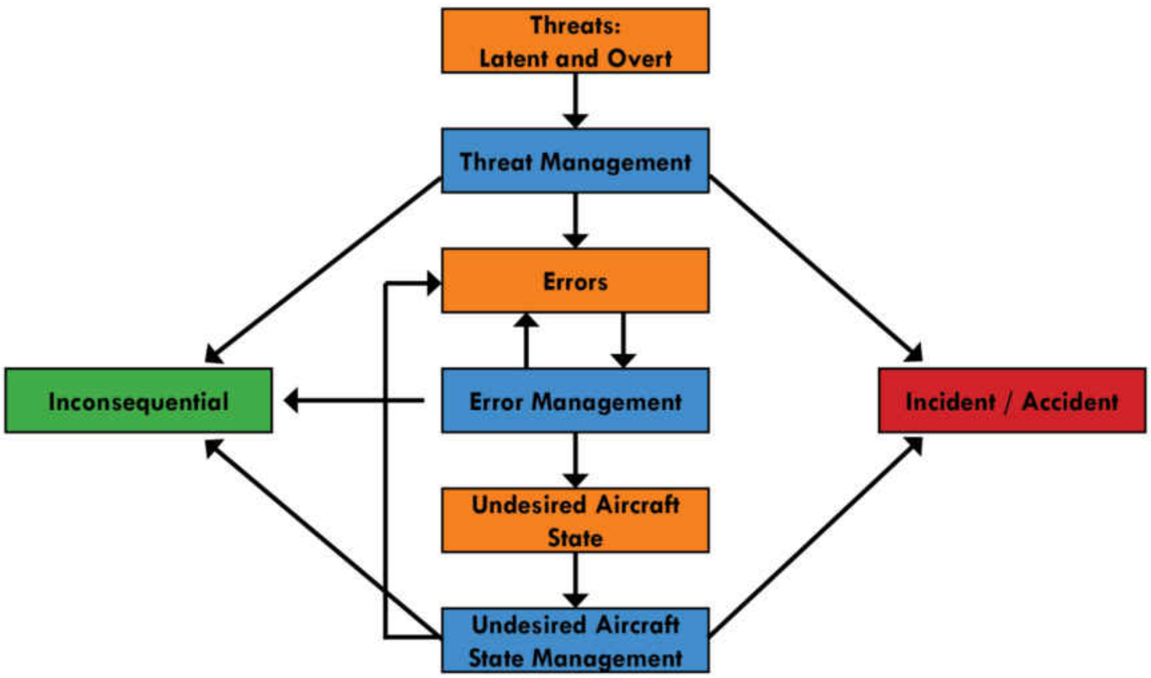
Two data verification roundtables were conducted by the Steering Committee over 5 days in late October and November. Each observation was reviewed for accuracy and consistency. In some cases, similar events were found to be coded differently by different observers and were corrected to a consisted code. In other cases, events were logged as ‘errors’ where there was no existing guidance or standard in company documentation. These were recorded in a separate file outside of the LOSA as opportunities for improvement and were then removed from the LOSA dataset.

THE THREAT AND ERROR MANAGEMENT MODEL (TEM)

The framework of LOSA is based on the University of Texas Threat and Error Management model. This section discusses TEM, and its application within LOSA. The definitions used in this section have been taken directly from *ICAO Doc 8309, Line Operations Safety Audit (LOSA)* where a more detailed discussion can be found.

TEM proposes that threats (such as adverse weather), errors (such as a pilot selecting a wrong automation mode), and undesired aircraft states (such as an altitude deviation) are everyday events that flight crews must manage to maintain safety. Therefore, flight crews that successfully manage these events regardless of occurrence are assumed to increase their potential for maintaining adequate safety margins. It is this notion that provides the overarching objective of TEM—to provide the best possible support for flight crews in managing threats, errors, and undesired aircraft states (Merritt & Klinect, 2006).

Figure C: Threat and Error Management Model



Threats

Threats are external situations that must be managed by the cockpit crew during normal, everyday flights. Such events increase the operational complexity of the flight and pose a safety risk to the flight at some level.

Threats may be expected or anticipated and, therefore, the crew may brief in advance. Threats may also be unexpected. As they occur suddenly and without any warning, there is no possibility for the crew to brief in advance. External threats may be relatively minor or major.

Errors originated by non-cockpit personnel are considered external threats. For example, if the cockpit crew detects a fuel loading error made by ground staff, it would be entered as an external threat, not an error. The crew was not the source of the error (although they must manage it, as they would any other external threat). Other examples of non-cockpit crew errors that would be entered as external threats are errors in Air Traffic Control (ATC) clearances discovered by the crew, dispatch paperwork errors and discrepancies in passenger boarding counts by cabin attendants.

Table 4: LOSA Threat Categories

Environmental Threats	Examples
Weather	Icing conditions, Thunderstorms, Crosswinds, Windshear
Airport	Airport construction, Contaminated runways, out-of-service navaids
ATC	Challenging/Late clearances, Runway change, Non-standard phraseology
Environmental Operational Pressure	Traffic (air/ground congestion), TCAS alert, High terrain
Airline Threats	**Examples**
Aircraft Malfunction	Aircraft malfunction unexpected by crew, MEL items with operational implications, Automation events
Airline Operational Pressure	Operational time pressure (delays, OTP, late arriving crew or aircraft)
Cabin/Cockpit	Cabin event/distraction/interruption, Flight Attendant error, significant cockpit distraction/interruption
Dispatch/Paperwork	Dispatch/Paperwork error or event
Ground/Ramp	Ground/Ramp error or event
Ground Maintenance	Ground Maintenance error or event
Manuals/Charts	Errors associated with Approach Charts or Manuals

Errors

Cockpit crew error is defined as an action or inaction by the crew that leads to deviations from organizational or flight crew intentions or expectations. Errors in the operational context tend to reduce the margin of safety and increase the probability of accidents or incidents. Errors may be defined in terms of non-compliance with regulations, Standard Operating Procedures (SOPs) and policies, or unexpected deviation from crew, company or ATC expectations. Errors observed may be minor (selecting the wrong altitude into the mode control panel (MCP), but correcting it quickly) or major (forgetting to do an essential checklist).

Table 5: LOSA Error Categories

Aircraft Handling Errors	Examples
Automation	Failure to use flight directors, Wrong altitude entered
Flight Control	Decision to use wrong thrust/power, Wrong flaps setting
Ground Navigation	Attempting/turning down wrong taxiway, Failure to hold short
Manual Handling	Unintentional vertical deviation, Speed deviation by choice
Systems/Instrument/Radio	Wrong altimeter settings, Wrong TCAS setting, Using equipment placarded as INOP
Procedural Errors	**Examples**
Briefing	Omitted approach briefing, Brief performed late
Callout	Incorrect approach callouts, Nonstandard landing callouts
Checklist	Checklist not performed to completion, Self-initiated checklist (not called for by CA)
PF/PNF	PF makes own automation mode changes, PNF carries out PF duties
SOP Cross Verification	Failure to cross-verify altimeter settings, Failure to clarify MEL or logbook entry
Other Procedural	Duties performed at inappropriate time, Pushback without clearing left or right
Communication Errors	**Examples**
Pilot to Pilot	Crew miscommunication of information, Misinterpretation of ATIS, Sterile cockpit violation
Crew to External	Use of nonstandard ATC phraseology, failure to give readback to ATC

LOSA considers three possible *responses* by crews to errors:

1. **Trap:** An active flight crew response in which an error is detected and managed to an inconsequential outcome;
2. **Exacerbate:** A flight crew response in which an error is detected but the crew action or inaction allows it to induce an additional error, Undesired Aircraft State, incident or accident; and
3. **Fail to respond:** The lack of a flight crew response to an error because it was either ignored or undetected.

The outcome of the error is dependent upon the flight crew response. LOSA considers three possible *outcomes* of errors depending upon crew response:

1. **Inconsequential:** An outcome that indicates the alleviation of risk that was previously caused by an error;
2. **Undesired Aircraft State:** An outcome in which the aircraft is unnecessarily placed in a compromising situation that poses an increased risk to safety; and
3. **Additional Error:** An outcome that was the result of or is closely linked to a previous error.

Undesired Aircraft States (UAS)

An "Undesired Aircraft State" occurs when the flight crew places the aircraft in a situation of unnecessary risk. For instance, an altitude deviation is an Undesired Aircraft State that presents unnecessary risk. An Undesired Aircraft State may occur in response to a crew action or inaction (error). It is important to distinguish between errors and the Undesired Aircraft State that can result. If an Undesired Aircraft State is observed, there should always be a crew error that is responsible for this undesired state. Such errors may be miscommunications, lack of proficiency, poor decision making or wilful violation of regulations.

Table 6: LOSA UAS Categories

Undesired Aircraft States	Examples
Aircraft Handling	Low speed deviation, Unnecessary weather penetration, Unstable approach
Ground Navigation	Runway incursion, Wrong taxiway
Incorrect A/C Configuration	Incorrect systems/instrument/radio configuration, incorrect engine configuration

LOSA considers three possible crew *responses* to Undesired Aircraft States:

1. **Mitigate:** An active flight crew response to an Undesired Aircraft State that results in the alleviation of risk by returning from the Undesired Aircraft State to safe flight;
2. **Exacerbate:** A flight crew response in which an Undesired Aircraft State is detected, but the flight crew action or inaction allows it to induce an additional error, incident or accident; and
3. **Fail to respond:** The lack of an active flight crew response to an Undesired Aircraft State because it was ignored or undetected.

LOSA considers three possible *outcomes* to Undesired Aircraft States:

1. **Recovery:** An outcome that indicates the alleviation of risk that was previously caused by an Undesired Aircraft State;
2. **End State/Incident/Accident:** Any undesired ending that completes the activity sequence with a negative, terminal outcome. These outcomes may be of little consequence, for example, a long landing or a landing too far to the left or right of the centreline, or may result in a reportable incident or in an accident; and
3. **Additional error:** The flight crew action or inaction that results in or is closely linked to another cockpit crew error.

LOSA SAMPLE

The LOSA sampled 83 flight sectors during the 10-week observation period, representing approximately 2% of the total sectors flown by the company in that period.

Eight Observers collected data, completing on average 10.3 observations each with no member of the group completing fewer than 8. Sampling succeeded in capturing a number of sectors for each aircraft type which was proportional to the total number of flight hours flown by that type annually. Due to the number of flight crew operating the HS748 and the limited future of the aircraft in the fleet, the decision was made to not observe flights on this aircraft type for the LOSA.

Sectors were sampled throughout the Calm Air network and included passenger flying, all-cargo freighter flights, as well as several charter flights flying in and out of 16 airports. Flight duration ranged from 0:10 to 3:29 with an average of 1:13 (SD=40 mins). A late departure was noted if the aircraft taxied from the gate more than 10 minutes past the scheduled departure time.

Efforts were made by the Steering Committee to see that sectors which were known to be specifically sensitive to flight crews (i.e.; freighter flights to destinations in northwest Ontario and high-arctic Nunavut) were sampled, however after several failed attempts due to weather and operational changes this became logistically impractical to complete by the end of the observation period. A map of the observed sectors, along with the frequency of the aircraft types observed can be found on the following page.

Flight crews were surveyed for basic demographic data at the end of the observation. On average, Captains had twice as much experience as First Officers, both in total flying time and total flight time on the aircraft type.

Descent and approach information was also captured for each sector. In slightly more than half of the observations, the crew conducted the approach briefing *before* the top of descent (TOD).

Visual Meteorological Conditions (VMC) on approach were dominant within the sample. Accordingly, a visual approach was the most frequently observed type of approach.

While autopilot disconnect altitudes were not generally recorded by observers, 87% of approaches were flown with the autopilot engaged.

Table 7: Sample Descriptives

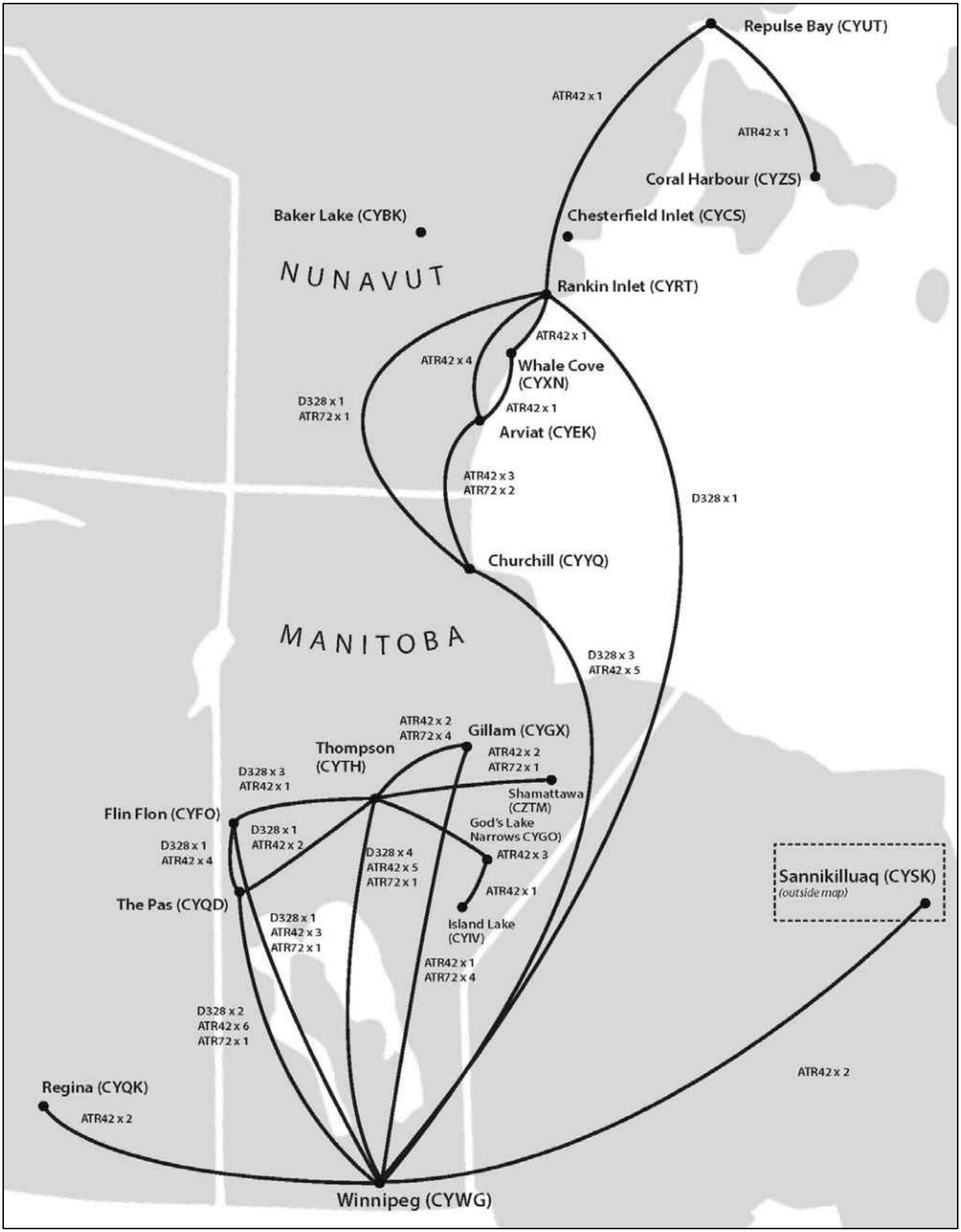
Aircraft Type	Frequency
ATR42	51 (55.4%)
D328	17 (20.5%)
ATR72	15 (18.1%)
HS748	0 (0.0%)
Total	*83 (100.0%)*
Late Departure	**Frequency**
Yes	46 (55.4%)
No	37 (44.6%)
Total	*83 (100.0%)*
Pilot Flying	**Frequency**
Captain	46 (55.4%)
First Officer	37 (44.6%)
Total	*83 (100.0%)*
Crew Familiarity	**Frequency**
CAPT/FO *Had* Flown Together Before	73 (88.0%)
CAPT/FO *Had Not* Flown Together Before	10 (12.0%)
Total	*83 (100.0%)*
CAPT Experience	**Average (Hrs)**
Total Flight Time	10,798
Flight Time on Type	2,108
FO Experience	**Average (Hrs)**
Total Flight Time	5,475
Flight Time on Type	1,106
Briefing Complete Before TOD	**Frequency**
Yes	48 (57.8%)
No	35 (42.2%)
Total	*83 (100.0%)*
Descent Began At or Before TOD	**Frequency**
Yes	77 (92.8%)
No	6 (7.2%)
Total	*83 (100.0%)*
Descent Got Significantly Above or Below Normal Profile	**Frequency**
Yes	9 (10.8%)
No	74 (89.2%)
Total	*83 (100.0%)*
Weather on Approach	**Frequency**
VMC	69 (83.1%)
IMC	14 (16.9%)
Total	*83 (100.0%)*
Type of Approach Flown	**Frequency**
Visual	61 (73.5%)
Non-Precision	16 (19.3%)
Precision	6 (7.2%)
Total	*83 (100.0%)*
Visual Approach Backed-up by Instrument System	**Frequency**
Yes	36 (59.0%)
No	15 (41.0%)
Total	*61 (100.0%)*
Hand-Flown/Autopilot	**Frequency**
Autopilot	72 (86.7%)
Hand-Flown	11 (13.3%)
Total	*83 (100.0%)*
Approach Got Significantly Above or Below Normal Profile	**Frequency**
Yes	3 (3.6%)
No	80 (96.4%)
Total	*83 (100.0%)*

Table 8: LOSA 2014 Observation List

Obs No	ID No	AC Type	Departure	Arrival	Flight Time
1	7	D328	YWG	YYQ	1.8
2	8	D328	YRT	YWG	2.6
3	9	ATR42	YYQ	YWG	2.4
4	10	ATR72	YWG	YQD	1.6
5	11	ATR72	YFO	YWG	1.4
6	12	ATR42	YTH	YGO	0.7
7	13	ATR42	YGO	YIV	0.3
8	14	ATR42	YRT	YEK	0.6
9	15	ATR42	YRT	YEK	0.7
10	16	ATR42	YEK	YYQ	0.6
11	17	ATR42	YEK	YRT	0.7
12	18	D328	YYQ	YWG	1.6
13	21	ATR72	YWG	YGX	2.0
14	22	ATR42	YTH	YGX	0.7
15	23	ATR42	YYQ	YWG	2.7
16	24	ATR42	YWG	YSK	3.5
17	25	ATR42	YWG	YQD	1.2
18	26	ATR42	YFO	YWG	1.6
19	27	ATR72	YWG	YTH	1.7
20	28	ATR72	YTH	YGX	0.7
21	29	D328	YTH	YFO	0.7
22	30	ATR72	YTH	ZTM	0.8
23	31	ATR42	YEK	YYQ	0.7
24	32	D328	YFO	YWG	1.2
25	33	D328	YTH	YWG	1.3
26	34	ATR42	YEK	YXN	0.4
27	35	ATR42	YXN	YRT	0.3
28	36	ATR72	YTH	YGX	0.6
29	37	ATR72	YGX	YWG	1.8
30	38	ATR42	YFO	YQD	0.4
31	39	ATR42	YQD	YWG	1.2
32	40	ATR42	YSK	YWG	2.2
33	41	ATR42	YTH	ZTM	1.0
34	42	D328	YWG	YQD	1.1
35	43	ATR42	YWG	YYQ	2.4
36	44	ATR42	YWG	YTH	1.9
37	45	ATR42	YTH	YWG	1.6
38	46	ATR42	YWG	YQD	1.3
39	47	ATR42	YQD	YFO	0.2
40	48	ATR72	YWG	YGX	1.7
41	49	ATR72	YGX	YTH	0.5
42	51	ATR42	YTH	YWG	1.7

Obs No	ID No	AC Type	Departure	Arrival	Flight Time
43	52	ATR42	YTH	YGO	0.7
44	53	ATR42	YGO	YTH	0.7
45	54	D328	YWG	YYQ	1.8
46	55	D328	YYQ	YRT	0.9
47	56	D328	YWG	YTH	1.1
48	57	D328	YTH	YFO	0.6
49	58	ATR42	YWG	YQR	1.3
50	59	ATR42	YQR	YWG	1.4
51	66	ATR42	YRT	YUT	1.0
52	93	ATR42	YUT	YZS	0.7
53	102	ATR42	YEK	YRT	0.7
54	103	ATR72	YWG	YGX	1.9
55	104	ATR72	YGX	YTH	0.6
56	105	ATR42	YWG	YTH	0.7
57	106	ATR42	YWG	YGX	1.9
58	108	ATR42	YGX	YWG	1.8
59	109	D328	YWG	YQD	1.0
60	110	D328	YQD	YFO	0.2
61	111	ATR42	YWG	YQD	1.5
62	112	ATR42	YQD	YFO	0.4
63	113	ATR42	ZTM	YTH	1.0
64	114	ATR72	YYQ	YEK	0.7
65	115	ATR72	YEK	YYQ	0.7
66	116	ATR42	YWG	YQD	1.2
67	117	ATR42	YFO	YWG	1.3
68	118	ATR42	YWG	YTH	1.7
69	119	ATR72	YYQ	YRT	1.7
70	120	D328	YWG	YTH	1.2
71	121	ATR42	YWG	YFO	1.8
72	122	ATR42	YFO	YTH	0.8
73	123	ATR42	YWG	YQD	1.5
74	124	ATR42	YQD	YTH	0.8
75	125	D328	YTH	YQD	0.8
76	126	ATR42	YTH	YQD	1.9
77	127	D328	YWG	YTH	1.3
78	129	D328	YTH	YFO	0.6
79	130	ATR42	YWG	YYQ	2.8
80	131	ATR42	YYQ	YWG	2.0
81	132	ATR42	YWG	YQD	1.6
82	133	ATR42	YQD	YFO	0.4
83	134	ATR42	YYQ	YEK	0.7

Figure D: LOSA 2014 Observation Map



THREATS

LOSA threat prevalence and findings are detailed below by phase of flight and tabulated by threat category.

Table 9: Threat

Threat Prevalence		Frequency
Environmental Threats		*42% (78)*
Weather	42% (32)	
Airport	4% (8)	
ATC	16% (29)	
Environmental Operational Pressure	5% (9)	
Airline Threats		*58% (106)*
Aircraft Malfunction	23% (42)	
Airline Operational Pressure	8% (15)	
Cabin/Cockpit	11% (21)	
Dispatch/Paperwork	4% (8)	
Ground/Ramp	8% (15)	
Ground Maintenance	1% (1)	
Manuals/Charts	2% (2)	
Total		*100% (184)*
Threat Discussed by Crew Prior to Encountering		
Yes		34% (62)
No		66% (122)
Total		*100% (184)*
Threat Outcome		
Inconsequential		84% (155)
Lined to Flight Crew Error		16% (29)
Total		*100% (184)*

LOSA observers recorded a total of 184 threats over the course of 83 observations, an average of 2.2 threats per flight. The vast majority of threats were encountered by crews during only two phases of flight: Pre-departure/Taxi (42%), where crews were more likely to encounter Airline threats, and Descent/Approach/Landing (33%) where they were more likely to encounter Environmental threats.

Figure E: Threat Prevalence by Phase of Flight

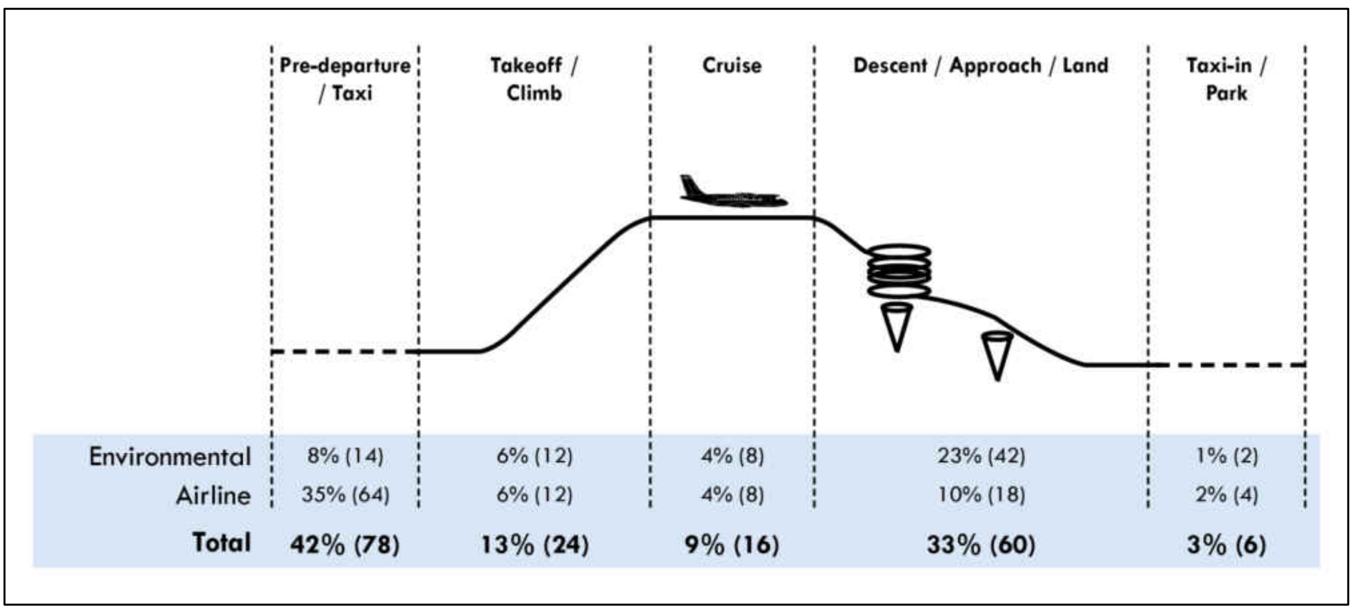


Figure F: Top Threats Bar Graph

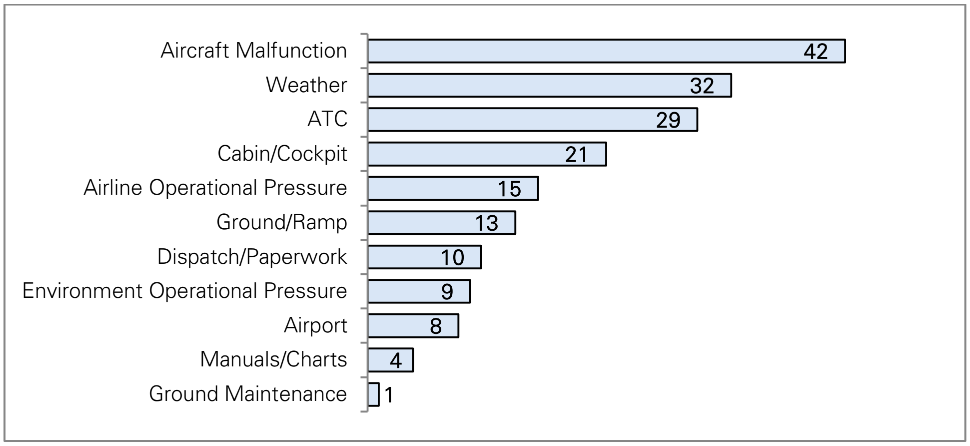
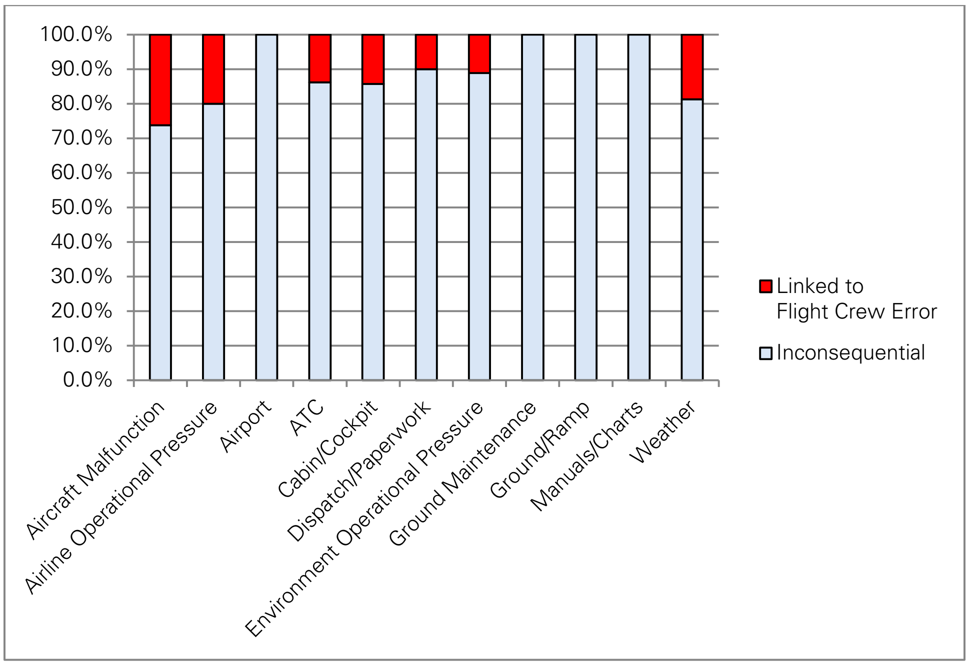


Figure G: Threat Outcomes



LATENT THREATS

During the Data Verification Roundtables, the Steering Committee encountered a number of findings entered by observers which did not clearly fit into the TEM/LOSA framework and were not consistently reported by observers, though they did have validity as complexity which the crew had to manage. While these entries were removed from the dataset, the Steering Committee elected to have them discussed in the final report as *latent* threats. A latent threat is an event or condition which is generally hidden within the system and may not be obvious to the flight crew, such as organizational culture, equipment design issues, or optical illusions.

In particular, there are 3 latent threats which were prevalent during the LOSA observation period which merit acknowledgement:

- **Area of Operations:** The majority of the organization's area of operations lay outside of ATC radar coverage and controlled airspace; only two of the airports which were observed were served by an ATC tower. The vast majority of flights were flown into or out of airports in Class E control zones or Class G uncontrolled airspace where crews were required to ensure separation from VFR and in some cases other IFR aircraft. While all of the airports captured in the LOSA sample were served by approach path lighting or electronic glideslope, the small communities in very remote areas can offer limited horizons during hours of darkness and present optimal conditions for "black hole" effect and somatogravic illusions for flight crews.

- **Pilot Scheduling/Workload:** The observation period ran from August until mid-October. Traditionally, the company does additional flying in the summer season (fishing lodges, forest fire evacuations); it is also an understandably desired employee vacation period, which the use of line pilots as LOSA observers would have exacerbated. A review of monthly flight times for the observation period as compared to the same period in 2013 revealed that ATR flight crews flew about the same number hours (~58 hrs/mo) while Dornier crews flew slightly more (~49 hrs/mo).The resultant effect was that certain elements of the pilot group shouldered a greater portion of the workload than other months where flying hours were more evenly distributed. While the assessment of pilot fatigue by a jumpseat observer would be highly subjective, onset of fatigue can be insidious and can affect every aspect of human performance.
- **RNAV Approach Authority (ATR42/72):** At the time of the LOSA, flight crew operating ATR42/72 were authorized for RNAV terminal and enroute operations, but restricted from conducting IFR RNAV instrument approach procedures despite being equipped with approach-capable flight management systems. The reasons for the restriction is related to flight simulator equipage and is beyond the scope of this report, however flight crews were faced with having FMS equipment in their aircraft which could be used to enhance situational awareness but lacked the authority (and therefore the procedures and training) to make use of the system to the fullest extent. This had the added effect of varying individual levels of systems knowledge, personal work-around procedures and strategies being used throughout the pilot group.

ENVIRONMENTAL THREATS

Environmental Sub-Threat: Weather

Flight crews managed the most prevalent weather threat – thunderstorms – very effectively, displaying high levels of situational awareness and being willing to delay flight progress to mitigate risk.

Table 10: Environmental Sub-threat - Weather

Weather	Frequency
Thunderstorms/turbulence	13
Icing only	7
Other adverse weather threat	5
Crosswind, tailwind, gusty or high winds aloft	4
IMC only	3
Turbulence only	1
Total	*33*

- Using the weather radar in position on the runway to scan the departure path, and then asking ATC for an immediate turn after takeoff in order to avoid the worst of the weather
- Active use of weather radar enroute to deviate around convective weather and discussing contingency plans
- Captain delayed the departure by 30 minutes to allow thunderstorms to pass over the airport.

In several cases, crews were either unable to access current weather information for their destination, or the information that they obtained had changed by the time of arrival.

- Crew expected VFR weather at destination without weather reporting; weather turned out to be overcast at between 900-1000 feet.
- Destination airport wind information was not available, so the crew picked up weather from the nearest airport which was reporting (90NM away); the crew conducted a straight-in approach with a tailwind which resulted in an unstable approach.
- Crew obtained weather from a CARs operator prior to descent. Clouds were reported to be scattered at 1000 feet; actual conditions were found to be overcast at 1200 feet on the approach.

Environmental Sub-Threat: Airport

The airport threats encountered were largely related to conditions at the time of the flight as well as the airport facilities themselves.

Table 11: Environmental Sub-threat - Airport

Airport	Frequency
Other airport threat	4
Other runway threats	2
Contaminated taxiway/runway	1
Total	*7*

- Birds on the runway and in the area of the approach path
- 'Misleading' PAPI indications on approach
- Two windsocks installed next to each other, making it difficult for the crew to interpret on short final (airport upgrades were in progress)
- In one case, the crew spotted an individual walking parallel to the runway approximately 20 feet from the edge while taxiing for departure.

Environmental Sub-Threat: ATC

Air Traffic Control is often cited in LOSAs for providing a meaningful proportion of threats; this also held true in this safety audit. ATC instructions often present the crew with some form of 'change' which must be understood, briefed and managed between the flight crew, particularly when the change was not anticipated. Many ATC threats would be considered as benign, everyday aspects of flight in controlled airspace, however crews encountered many which required active intervention and management.

Table 12: Environmental Sub-threat - ATC

ATC	Frequency
Other ATC threat	14
ATC command – challenging clrnces, late changes	6
ATC error	3
ATC runway change	3
ATC language difficulty	1
ATC radio congestion	1
Total	*29*

- ATC cleared a flight to wrong-way altitude for direction of flight. The crew did not question the clearance; the controller eventually queried the crew as to why they had stopped their climb (at their assigned level-off altitude) and were then cleared to their flight planned altitude.
- Runway changes due to shifting winds or offered to the crew by ATC for efficiency
- When taxiing for departure at an uncontrolled airport, crews interrupted checklists or briefings in order to accept an IFR clearance from FSS radio (4 cases)
- Flight was vectored in tight for a visual approach. The beacon crossing restriction was cancelled and ATC asked the crew to 'keep it in tight'
- Crew inbound to land was cleared to a waypoint which was not easily or readily located on a chart. Crew had correct spelling, though took several minutes to locate the waypoint – was only published on the 'ARKAY ONE' departure chart in the CAP.
- ATC Tower called an aircraft on short final seeking information about where the crew planned to exit the runway

Environmental Sub-Threat: Environmental Operational Pressure

All events logged in this category by observers related to conflicting traffic and aircraft sequencing in and out of uncontrolled environments.

Table 13: Environmental Sub-threat - Environmental Operational Pressure

Environmental Operational Pressure	Frequency
Traffic (air or ground congestion)	9
Total	*9*

- VFR aircraft operating in the vicinity (with and without transponder, not always represented on TCAS)
- Inaccurate/inconsistent estimates from other aircraft, and multiple aircraft inbound to land at destination with same estimated time of arrival
- ATC gave a crew a departure clearance with a restriction to be airborne by a specific time due to inbound traffic, however the traffic was several minutes earlier than expected. Crew taxied clear of runway and cancelled their clearance to avoid rushing the departure.
- A particular challenge occurs when crews attempt to estimate the time available to taxi, complete checklists and briefings and for the Flight Attendant(s) to secure the cabin for departure when other aircraft are inbound to land.

AIRLINE THREATS

Airline Sub-Threat: Aircraft Malfunction

Crews occasionally operated aircraft with equipment deferred in accordance with the Minimum Equipment List (MEL); observers noted high levels of awareness and management of the associated operational implications and substitute procedures (APU generator [D328], brake temperature monitoring system [ATR], propeller synchrohpaser [ATR]).

Table 14: Airline Sub-threat – Aircraft Malfunction

Aircraft Malfunction	Frequency
Aircraft malfunction unexpected by crew	26
MEL/CDL with operational implications	8
Other aircraft malfunction threat	5
Automation event or anomaly	3
Total	*42*

Various relatively minor malfunctions and anomalies were encountered, including issues with an audio control panel, a missing control knob from a transponder which prevented a crew from squawking their assigned code, a yaw damper that would not engage, an altimeter which was intermittently presenting an 'OFF' flag, and flight idle gate that would not open on touchdown. There were also two anomalies which presented themselves with regularity in the dataset:

- **Master Caution / EFIS COMP – Heading (ATR)**: This alerts the crew that there is a discrepancy between the Captain and FO heading information in excess of 5°. This alert was highly prevalent; on one observation it occurred twice during a 14 minute flight and on another it occurred three times within 15 minutes on a 40 minute flight, and all occurrences in the dataset were seen on flights operating in Northern Domestic Airspace. The flight crew did not always acknowledge the alert, only reaching up to cancel it the Master Caution. The QRH checklist was not consulted in any case, though the checklist items were completed from memory by the crew.
- **Master Caution / BLEED SOV FAIL (D328)**: This alert is very similar to the one described above; the fault was a common occurrence and crews reset the valve switch, completing the QRH checklist by memory without physically referencing it.

A number of issues in the cabin were brought to the flight crews' attention by flight attendants. These issues included a problem with a galley service panel and several issues with lavatory doors; one door continuously coming off of its tracks, and another door jammed closed while someone was in the lavatory.

Finally, there were two abnormalities which were serious enough that they required air turnbacks. One event involved a Master Warning / Elec Smoke immediately after takeoff (ATR), and the other involved uncontrollable cockpit/cabin temperature (hot) due to a malfunction in the air conditioning system.

Airline Sub-Threat: Airline Operational Pressure

While this sub-threat category is open to some degree of subjectivity, observers noted events which had the potential to create internally-driven (individual) or externally-driven (organization) expectations to rush, continue operation, or to deviate from accepted procedure.

Table 15: Airline Sub-threat – Airline Operational Pressure

Airline Operational Pressure	Frequency
Operational time pressure (delays, OTP, late arriving pilot or aircraft)	11
Other airline operational pressure threat	4
Total	*15*

- **Crew planning & coordination close to departure time:** Issues were noted with late delivery or amendments to passenger manifests, the absence of a passenger manifest (charter flight), and delays in confirming fuel loads in order to minimize possible bumping of baggage or cargo.
- **Late departures:** Late departures were noted in 55% of the LOSA sample, though observers only noted this as a threat to the crew in 6 cases (cargo/loading delay, lightening/thunderstorms in area, late arrival of aircraft, crew scheduling miscommunication), though none were found to be consequential.
- **Aircraft serviceability issues passed from crew to crew and implied expectation to continue operation:** There were two instances where observation crews accepted verbal information from the previous flight crew about intermittent serviceability issues, though maintenance had not been contacted, nor a defect entered in the aircraft journey logbook.

  In one of those cases, the previous Captain mentioned having difficulty with the cockpit/cabin temperature controller, but that he was able to get it working. The LOSA observer's entry explained, *"The Capt taking over called maintenance and asked them to check the system, no snag was recorded in the journey log, nothing was MEL'd. Maintenance's response was that they couldn't find anything wrong, it sounded like an air cycle machine might be acting up, but it was an 8 hour job and $30,000 part."* The flight departed and resulted in an air turnback when the temperature could not be controlled.

Airline Sub-Threat: Cabin/Cockpit

Table 16: Airline Sub-threat – Cabin/Cockpit

Cabin/Cockpit	Frequency
Cabin event/distraction/interruption	12
Flight attendant error	4
Significant cockpit distraction/interruption	3
Other cabin/cockpit threat	2
Total	*21*

Over half of these threats logged by observers involved the interruption of a checklist or briefing by a call from the Flight Attendant (main door closure, commissary order, and 'cabin secure'). In some cases, crews acknowledged the interruption and re-ran checklists, though in many others the crew carried on. Observers noted that crews were very willing to interrupt their task and immediately communicate with the Flight Attendant rather than finishing their briefing/checklist and then responding. Despite this, only one instance was linked to a flight crew error.

The sterile cockpit policy between cockpit and cabin crew was not complied with in two cases, though it appeared that the Flight Attendant may have been unaware of the aircraft's position.

In one case, a flight attendant was seriously injured after attempting to un-jam a lavatory door (finger); the flight crew asked her to come the flight deck so that they could assess the extent of the injury.

Another relevant aspect of this sub-threat group is that 86% occurred at or below 10,000ft, and 50% of threats happened while the aircraft was on the ground.

Airline Sub-Threat: Dispatch/Paperwork

Table 17: Airline Sub-threat – Dispatch/Paperwork

Dispatch/Paperwork	Frequency
Dispatch/Paperwork Error	6
Other dispatch/paperwork threat	1
Dispatch/paperwork event	1
Total	*8*

Threats logged in this category were primarily related to the operational flight plan (OFP). Errors on the OFP were noted by crews with respect to routing & cruising altitude, the omission of MEL items on the aircraft and inaccurate aircraft weight and balance configuration - these were resolved through collaborative discussion with Flight Dispatch. There was a case however where the crew did not notice that their expected routing (direct to destination) was actually filed via airways until they received their clearance from ATC, despite having a copy of their flight plan.

Airline Sub-Threat: Ground/Ramp

Table 18: Airline Sub-threat – Ground/Ramp

Ground/Ramp	Frequency
Other Ground/Ramp threat	9
Ground crew error	6
Total	*15*

Crews encountered threats on the ground related to aircraft movements and aircraft loading and unloading.

Roughly half of the threats that were logged were associated with aircraft arriving at a destination and ground support was not ready and available. In several instances, marshallers were not available to direct aircraft on the ramp, and ground power units (GPU) were not available prior to shutdown.

Aircraft loading errors were encountered, presenting a threat for flight crews to manage. There was an event where dangerous good were found to be loaded on the aircraft without the crew being aware (the crew coordinated with Cargo and obtained a NOTOC), and another where cargo had been improperly loaded (paint loaded on its side and leaked) in the cargo compartment between the cockpit and the cabin (crew contacted Maintenance for guidance and cleaned up the mess). Other errors comprised of events where load control forms detailing the cargo weight on the aircraft were not available to the crew.

Observers separately logged two threats related to weight and balance issues onboard ATR72 'combi' aircraft where the crew intervened. In one case, passengers were deplaning and cargo crews were unloading the aircraft simultaneously and the crew became concerned about the aircraft becoming 'tail-heavy' (crew asked cargo to unload the tail baggage compartment first). In the other case, the crew arrived to find the aircraft loaded significantly 'nose-heavy' with cargo, and due to the low passenger load on that sector, passenger weight would not bring the center of gravity (CofG) into limits (the crew had cargo re-distribute the cargo on the aircraft).

Airline Sub-Threat: Ground Maintenance

Table 19: Airline Sub-threat – Ground Maintenance

Ground Maintenance	Frequency
Maintenance error	1
Total	*1*

The only threat logged in this category was related to the crew identifying a discrepancy with the "next maintenance required by XXXX" card inside the journey logbook (the crew contacted maintenance and resolved the issue).

Airline Sub-Threat: Manuals/Charts

Three of the four threats were logged in relation to approach plates found to be missing from the flight deck (aircraft libraries contain two copies of the relevant Canada Air Pilot volumes; one of those volumes was missing).

Table 20: Airline Sub-threat – Manuals/Charts

Manuals/Charts	Frequency
Other Manuals/Charts threat	4
Total	*4*

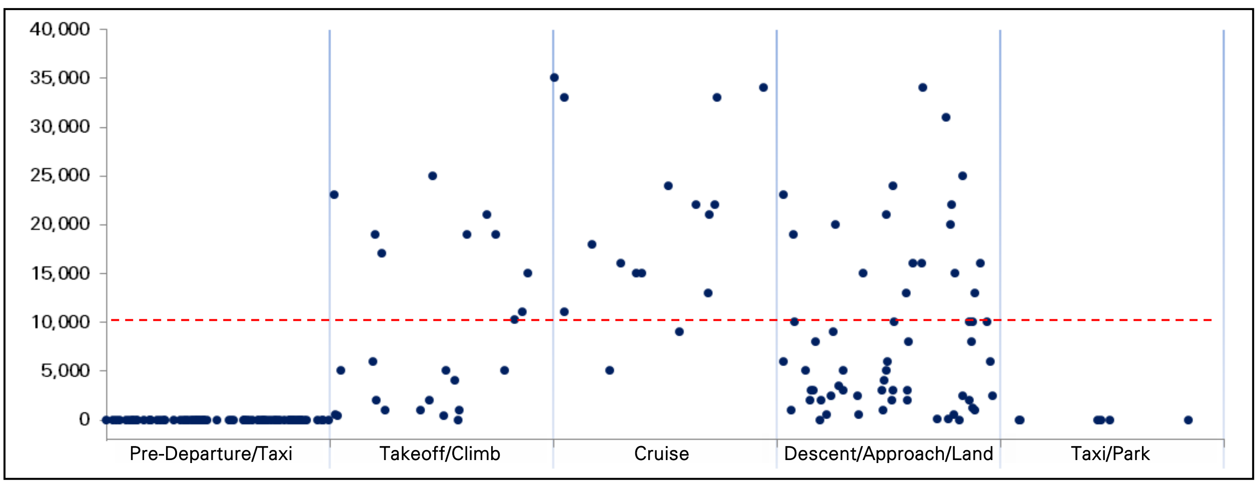
Summary

The crews that were observed discussed only 1/3 of the threats they encountered prior to encountering them. This may reflect weak threat awareness or identification, or perhaps that crews encounter certain threats so frequently that they have become accustomed to their existence. The most frequently discussed threats prior to their encounter were Weather (14%) and Aircraft Malfunction (8%). Conversely, the most frequently encountered threats which were not discussed prior to their encounter were Aircraft Malfunction (15%), ATC (13%) and Cabin/Cockpit (11%).

The vast majority of threats encountered (84%) resulted in inconsequential outcomes; in 29 cases though, crew mismanagement of the threat was linked to at least one error being committed. Aircraft Malfunction (11 cases) was the most frequent error-linked threat, followed by Weather (6 cases) and ATC (4 cases). Coincidentally, these same categories represent the most frequently encountered threats which were inconsequential as well.

A review of the altitude at which threats were encountered reveals the prevalence of threats at lower altitudes. The vast majority of threats were encountered below 10,000ft (78%), with nearly half (47%) occurring on the ground, suggesting that crews encounter most threats near the beginning and near the end of their flights.

Figure H: Threat Prevalence by Altitude



ERRORS

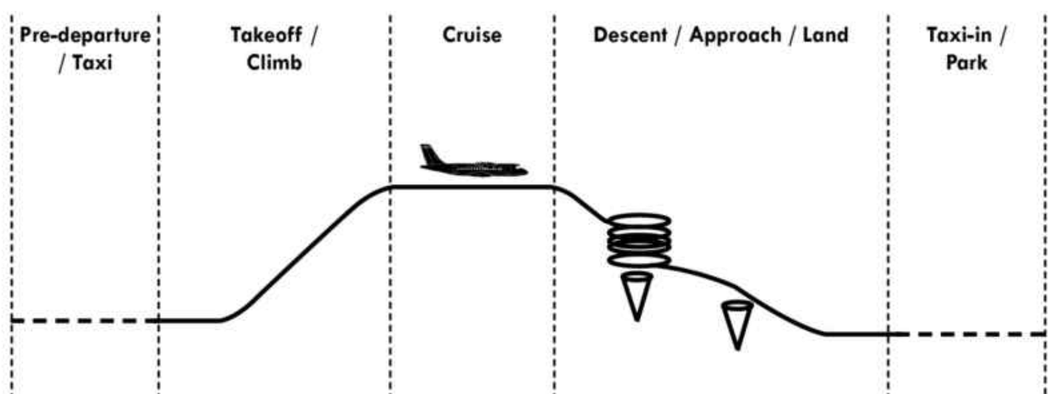
LOSA error prevalence and findings are detailed below by phase of flight and tabulated by error category.

Table 21: Error

Error Prevalence		Frequency
Aircraft Handling Errors		*25% (62)*
Automation	4% (10)	
Flight Control	4% (10)	
Ground Navigation	<1% (1)	
Manual Handling	7% (18)	
Systems/Instrument/Radio	9% (23)	
Procedural Errors		*58% (144)*
Briefing	2% (6)	
Callout	11% (28)	
Checklist	14% (34)	
Documentation	1% (3)	
PF/PNF	6% (15)	
SOP Cross Verification	9% (22)	
Other Procedural	15% (36)	
Communication Errors		*17% (42)*
Pilot to Pilot	11% (28)	
Crew to External	6% (14)	
Total		*100% (248)*

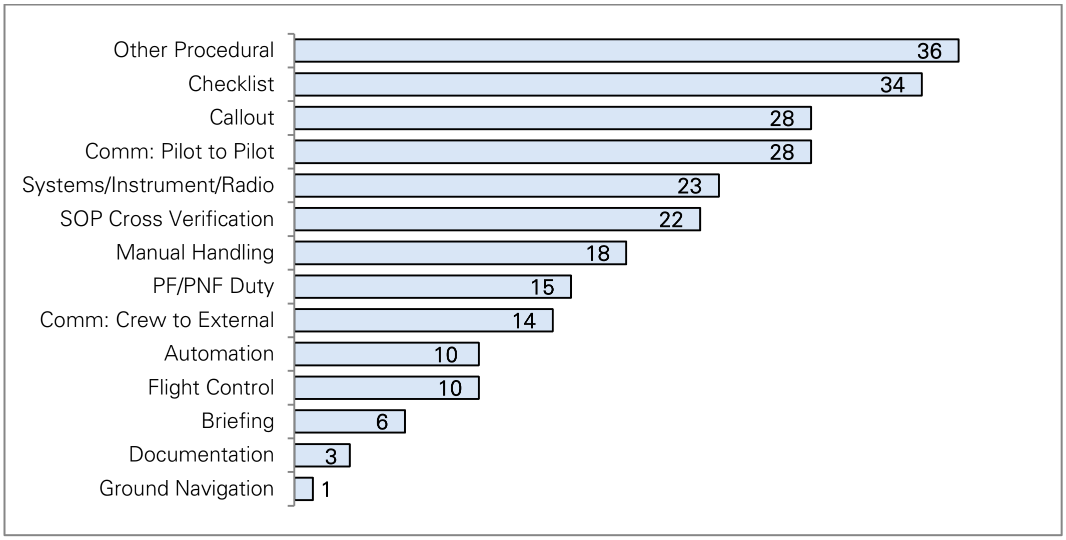
LOSA observers recorded a total of 248 errors over the course of 83 observations, an average of 3.0 errors per flight. The majority of errors occurred during Pre-departure/Taxi (25%), Takeoff/Climb (19%) and Descent/Approach/Landing (33%) phases of flight. In all phases, Procedural errors were the most frequently observed.

Figure I: Error Prevalence by Phase of Flight



	Pre-departure / Taxi	Takeoff / Climb	Cruise	Descent / Approach / Land	Taxi-in / Park
Aircraft Handling	6% (14)	4% (9)	<1% (1)	15% (37)	<1% (1)
Procedural	15% (37)	12% (30)	4% (11)	18% (44)	9% (22)
Communication	4% (10)	4% (9)	2% (5)	6% (15)	1% (3)
Total	**25% (61)**	**19% (48)**	**7% (17)**	**39% (96)**	**11% (26)**

Figure J: Top Errors Bar Graph



AIRCRAFT HANDLING ERRORS

Aircraft Handling Sub-Error: Automation

The errors noted in this category reflect errors in executing automation tasks, as well as decisions on how automated systems were used.

Table 22: Aircraft Handling Sub-Error - Automation

Automation	Frequency
Wrong MCP/FCU altitude setting dialed	2
Discretionary omission of FMC/FMGC data	1
Failure to execute a FMC/FMGC mode when needed	1
Inappropriate disconnection of automatics	1
Wrong MCP/FCU heading set or dialed	1
Wrong MCP/FCU mode left engaged	1
Total	*7*

Events related to autopilot and flight director use were noted:

- On departure, the heading bug was not aligned with the runway; when the autopilot was engaged at 1000 ft AGL, the aircraft immediately banked in the wrong direction
- Crew received a new clearance and entered it in the FMS, though 'NAV' mode was not selected. The aircraft flew through the desired track in 'HDG' mode; crew noticed the error when the aircraft was 2.4 NM left of the track in controlled airspace.

The decision to select a particular altitude in the altitude pre-selector was identified on multiple flights. In situations where the crew was flying above an overcast layer but anticipated VMC weather for the approach at destination, the crew set what they referred to as a *"VFR altitude"* in the pre-selector which was below the minimum IFR altitude (25NM safe altitude). There were cases where the aircraft broke out of cloud above the minimum IFR altitude and had visual contact with the ground; there were others however where risk was increased, as described by one observer:

> *"The Captain told the FO he was planning the visual approach into [destination] because the last weather out of [nearby airport] (approximately 50nm SSE of [destination]) was VFR at 3000 feet overcast and greater than 6 miles visibility.*
>
> *The Captain asked for an altitude of 1400 feet to be set in the ADU and began a descent on profile approximately 35nm from Gods Lake Narrows; the FO didn't challenge him on it. 1400 feet is the minimum altitude for the NDB approach into [destination] (100NM safe alt is 2500ft; 25NM safe alt is 2200ft).*
>
> *The weather in [destination] turned out not to be VFR. It was overcast at approximately 900-1000 feet with good visibility. The crew descended below the 25nm safe altitude and below published procedure turn altitudes and levelled off at 1400 feet ASL (700 feet AGL) approximately 7nm from the airport on the inbound approach track."*

It is worth noting that in the above described event, the aircraft inbound track and approach course were nearly aligned; the NDB is at the airport and there is no FAF for this approach. The aircraft levelled out at the MDA within the safe area, though this profile (700t AGL at 7NM from airport) generated a GPWS terrain warning due to configuration (noted in UAS section of this report, p.35).

Aircraft Handling Sub-Error: Flight Control

Events in this category were largely related to errors or omission or awareness.

- Crew did not conduct a 'max thrust' takeoff when taking off into icing conditions
- Crew forgot to reduce thrust from 'max takeoff' to 'max climb' after takeoff (detected and corrected at 7000ft)
- Crew advanced condition levers to 'max' prior to landing to 'provide better reverse thrust capability' (ATR72)
- PF requested flap extension above max flap extension speed (PNF advised and delayed extension until within limit)
- Several airspeed overspeed deviations during descent due to excess power
- Engine #2 over-torque to 96% during climb

Table 23: Aircraft Handling Sub-Error – Flight Control

Flight Control	Frequency
Wrong thrust/power settings	5
Other flight control error	2
Decision to use wrong thrust/power	1
Intentional Noncompliance – Other flight control error	1
Total	*9*

Aircraft Handling Sub-Error: Ground Navigation

The only event logged in this category related to a crew which began maneuvering for an incorrect taxi route which was quickly identified by the FO and corrected by the Captain.

Table 24: Aircraft Handling Sub-Error – Ground Navigation

Ground Navigation	Frequency
Attempting or turning down a wrong gate/taxiway/ramp/hold spot	1
Total	*1*

Manual Handling

The manual handling errors observed can be grouped into a handful of themes:

- **Above descent profile/High on approach:** Multiple instances were noted where the aircraft became high on the normal descent profile or high on the final approach path; some of the approach deviations were the result of the above-normal decent profile.
- **Speed deviations:** Multiple high speed events were noted, though unlike the profile deviations above, speed events were much more likely to result in an undesired aircraft state. Airspace speed violations were also noted several arrivals into Winnipeg, where there is a requirement to slow to 200kts or less when within 10NM and 3000ft AGL of the airport. In one case, the aircraft was at 230kts at 2300ft AGL 7NM from the airport and only began to slow in order to configure, and in another the aircraft was at 245kts at 2300ft AGL when ATC advised the crew, *"you have 100kts on the 737 in front of you"* and instructed them to slow.

Table 25: Aircraft Handling Sub-Error – Manual Handling

Manual Handling	Frequency
Unintentional speed deviation	5
Unintentional vertical deviation	4
Speed deviation by choice	2
Intentional Noncompliance – Intentionally flying a nonstandard visual approach	1
Intentional Noncompliance – Intentionally not following published Jepp procedures	1
Unintentional crosswind technique	1
Unintentional weather penetration	1
Total	*15*

The combination of these factors (multiple errors) resulting in an unstable approach was observed as an aircraft transitioned to a visual approach into Flin Flon. The crew was using an RNAV approach waypoint (FAF) to conduct a visual approach. The FMS/autopilot anticipated the turn to final approach inside the FAF and the approach was flown at high speed, attaining the approach path by short final. A 10kt tailwind was noted by the crew on short final, and combined with the flare which was initiated at REF+10, the aircraft floated and used up most of the runway in order to stop.

Finally, an event occurred where the crew intended to deviate around convective weather on descent, but ended in an inadvertent weather penetration. The crew had been briefing the approach when they were interrupted by a 'cabin secure' call from the Flight Attendant. During the interruption, the PF selected a heading to deviate around the weather ahead. When the crew resumed their briefing, they diverted their attention away from the weather; the initial heading was not sufficient and resulted in the aircraft flying through the convective cloud anyways.

Aircraft Handling Sub-Error: Systems/Instrument/Radio

The largest portion of Aircraft Handling errors belong to this category. Some of the notable events are detailed below.

Table 26: Aircraft Handling Sub-Error – Systems/Instrument/Radio

Systems/Instrument/Radio	Frequency
Other systems/inst/radio error	7
Wrong altimeter settings	4
Wrong TCAS setting	3
Incorrect climb or descent callouts	2
Wrong anti–ice setting	2
Wrong nav radio frequency dialed	2
Wrong ATC frequency dialed/selected	1
Wrong Bug Settings	1
Intentional Noncompliance – Other systems/inst/radio error	1
Total	*23*

- Nav Frequencies/Displays: Cases where a frequency was not set or selected, or where a display was not used when appropriate. As an example, a crew briefed the visual approached, backed up by the NDB; the crew flew the visual approach, however the NDB remained tuned to another frequency.
- System Tests: Several errors were logged where crews attempted to test the anti-skid braking system on the ATR while the aircraft was taxiing, which is potentially hazardous and can interfere with braking ability.
- TCAS Selection: Several instances were observed where crews had different mode selections on their TCAS displays, and appeared to be unintentional. As one observer detailed, on a departure out of Thompson, *"The Capt's TCAS was set for 40NM (Normal) and the FO's TCAS was set for 10NM (Down)"*. While there is no existing policy on how crews should display TCAS information and crews are generally free to set the display as the situation warrants, it was notable that there were no discussion between the crews about why they had the selections up that they did and often the setting for takeoff was the setting that was used during the arrival on the previous leg. It is worth noting that the TCAS system will issue both Traffic (TA) and Resolution Advisories (RA) regardless of what is being displayed to the pilots.

  The TCAS system will not however issue TA/RA information or guidance when the system is not turned on. It was observed on two flights that crews noticed the TCAS was not turned on prior to departure. Both events occurred on the same aircraft (ATR42 C-FCIJ), which upon further review is the only ATR aircraft in the fleet which is not automatically activated and requires crew activation on each flight. It is also worth noting that the aircraft is a Freighter aircraft which operates in non-radar and uncontrolled airspace for the vast majority of its flying.
- Incorrect Altimeter Settings: There were four instances where altimeters were set with the wrong altimeter setting, and thus displaying an inaccurate altitude. Three of these instances occurred during descent and in each case crews successfully trapped the error when it was caught in the Descent Checklist, or by reconfirming the correct setting with the FSS. The remaining instance occurred during the climb, *was not trapped* by the crew, and resulted in an altitude excursion. The crew was climbing to a cruising altitude of FL090 in northern domestic airspace and became distracted by a Master Caution alert; they failed to set their altimeters to 29.92 prior to level off, and subsequently leveled off 400ft above their cruise altitude.

PROCEDURAL ERRORS

Procedural Sub-Error: Briefing

The errors in this category are interesting because they appear to speak to cultural norms that exist in the organization, particularly with respect to visual approaches.

Table 27: Procedural Sub-Error - Briefing

Briefing	Frequency
Incorrect/incomplete approach brief	3
Intentional Noncompliance – Incorrect/incomplete approach briefing	2
Omitted approach briefing	1
Total	*6*

For reference, aircraft-specific SOPs at the time of the LOSA required that, (a) crews conduct approach briefings, and (b) and 'AMORTS'-style approach briefing be conducted *"when a visual approach is not assured"*. No explicit guidance existed as to how crews were to conduct briefings for visual approaches. Recall from the sample descriptives that visual approaches represented 74% of the approaches observed in the LOSA and that the Captain and First Officer had flown together before in 88% of the flights sampled. Crews commonly abbreviated the approach briefing in these circumstances, as was noted by the observers:

- *"VFR for runway XX"*
- *"The visual, backed up by the ILS"*
- *"What I did yesterday…cross track to the left"*

Discussion during the data verification process challenged whether these could be considered as errors when crews did not have explicit guidance on visual approach briefing standards. The entries were upheld when the observer provided context as to how the practice presented additional risk to the flight. In multiple cases, visual approaches were briefed where IMC conditions prevailed on the approach (in one of these cases, weather at the destination was not available to the crew). Observers noted that crews omitted basic details of how the approach would be flown, i.e.; the transition to the final approach course, configuration, minimum altitudes, or contingency plans if weather turned out to the lower than expected.

There was also a notable event where a crew was challenged by a transition/approach into an unfamiliar airport on while on a charter flight which lead them to a non-standard approach planning & briefing, though the situation resulted in an inconsequential outcome.

> *"Crew picked up the ATIS for YQR; RNAV 31 approach was in use. Aircraft and crew were not certified for RNAV approach and the only other approach to that runway was an NDB. Crew became distracted discussing how to conduct the approach, and their transition to the approach. They briefed a 'hybrid' NDB RWY 31 approach, setting up the ILS to RWY 13 with hopes that a backcourse signal would help them get better accuracy than an NDB only approach (no backcourse approach exists). While distracted with the approach briefing, the crew neglected to reduce the power and got an aircraft overspeed warning. The crew eventually called the field 'visual', and were cleared by ATC for a visual approach."*

Procedural Sub-Error: Callout

As detailed in the breakdown of this category, many errors were either the omission of a callout, or a pilot using an incorrect callout for the situation.

Table 28: Procedural Sub-Error - Callout

Callout	Frequency
Other callout error	10
Omitted altitude callouts	6
Omitted climb or descent callouts	4
Omitted approach callouts	3
Incorrect climb or descent callouts	2
Incorrect approach callouts	1
Incorrect V–speed callouts	1
Total	*27*

- **Omitted callouts:** Some of these errors were simply calls that were not made, particularly in response to a callout by the other pilot, such as when leaving the current altitude for another, calling 'clear right/left' when taxiing from parking or across a runway/taxiway, or altitude awareness calls on approach.

  In 6 cases, altitude capture calls were omitted. Context provided by the observer identified distraction as a factor in each; in the final 1000ft to the level-off altitude, the crews had been reviewing scoop sheets, approach plates, completing logsheet entries, or engaged in non-essential conversation. In one case, the crew was in discussion with the Flight Attendant regarding problems with the lavatory door. While none of these omissions resulted in consequential outcomes, they reflect breakdowns workload management and task scheduling.

- **Incorrect callouts:** The use of incorrect or substitute language or phraseology in callouts was noted. As an example, many crews replaced after landing/rollout calls (*"my aircraft/my pole"*) with phraseology used in aircraft they had previously operated (*"your pole/my pole"*). Similar to omissions, the use of incorrect callouts did not result in any consequential outcomes, though they do reflect a deviation from standards published in SOPs.

Procedural Sub-Error: Checklist

This sub-category represents the 2nd most frequent crew error type in the sample.

Table 29: Procedural Sub-Error - Checklist

Checklist	Frequency
Intentional Noncompliance – Checklist performed from memory	9
Intentional Noncompliance – Self–initiated checklist (not called for by CA)	5
Intentional Noncompliance – Omitted abnormal checklist	3
Omitted abnormal checklist	3
Omitted checklist	3
Checklist performed late or at the wrong time	2
Intentional Noncompliance – Checklist not performed to completion	2
Intentional Noncompliance - Self-initiated checklist (not called for by PF)	2
Intentional Noncompliance - Use of non-standard checklist protocol	1
Intentional Noncompliance – Omitted checklist	1
Missed checklist item	1
Wrong response to a challenge on a checklist	1
Other checklist error	1
Total	*34*

- **Checklist interrupted:** Interruptions were identified multiple times as threats to crews while completing checklists and briefings (the takeoff and approach briefings are items on the normal checklist), there is only one case logged where the observer felt that the crew mismanaged the threat. FSS called the flight to provide the crew with a departure clearance and a Captain stopped his takeoff briefing so that the FO could copy the clearance. When he was finished copying, the FO finished the Capt's takeoff briefing for him and continued on with the checklist.
- **Checklist item deferred:** There were events where a checklist item was differed so that the checklist could be completed out of sequence, with the intention of remembering to complete the deferred item later. In one instance, a crew elected to skip "Cabin Secure" (inconsequential) and in another, the crew deferred shutting off the bleed air to the cabin until the flight attendant had secured the cabin for departure (linked to additional error). The crew was required to depart with bleed valves off for performance reasons (ambient temperature); they forgot to deselect bleed air and took off with the bleed valves on.
- **Checklist completed from memory:** The instances where this was observed were confined almost entirely to the "Before Takeoff/Line Up" and "Shutdown" checklists, evenly split. The only exception was one event where the "Taxi" checklist was completed from memory.

  Similar, one event was recorded where an engine was started before both crew members were in their seats, without any checklist being completed.

  > *The crew had just unloaded the aircraft and were clearly ready to get the return flight going; the aircraft was secured expeditiously. As both crew members were getting settled in their seats, the Captain initiated a start on engine #2 prior to any checklist being completed. This seemed like a normalized procedure; the FO did not intervene and was completely aware of what was happening. All normal checklists were completed prior to taxi.*

- **QRH not referenced:** Crews dealt with malfunctions (ACM pack fault, EFIS COMP-HDG, flap malfunction, DC GEN fault) without consulting the Quick Reference Handbook without any consequential outcomes. In one event however the crew not only neglected to reference the QRH following an APM fault – they elected to simply turn off the APM for the remainder of the flight.
- **Checklist omitted:** The "Cruise" checklist/flow was the most frequently omitted checklist. There was only one other instance where the "Descent" checklist was forgotten by the crew until it was detected at 1400 ft AGL; the crew was operating a short sector with a 6000 ft cruise altitude.

Procedural Sub-Error: Documentation

The three errors logged in this subcategory relate to the following events:

Table 30: Procedural Sub-Error - Documentation

Documentation	Frequency
Wrong weight and balance information recorded	1
Misinterpreted items on flight documentation	1
Other documentation error	1
Total	*34*

- *"Proper C of G was not calculated prior to departure. Crew was radioed by CSAs with actual baggage location only after they had departed and were climbing out."*
- *"Flight plan accepted by Captain with incorrect aircraft configuration reflected (OEW & Index). Aircraft was in 42 seat config, flight plan showed them in 34 seats, this wasn't noticed until arrival 2 stations later."*

- *"The fuel slip was forgotten and therefore the fuel uplift was not able to be checked against the remaining fuel as written in the journey log. The first officer asked the captain if he got the fuel slip, however it was left in the fuel panel and the engines were already running. It was retrieved after the flight. The consequence was that the fuel uplift was not confirmed prior to departure other than checking the fuel gauges."*

Procedural Sub-Error: PF/PNF Duty

The dominant situation captured in this category by the observers occurred when the Pilot Flying (PF) made system, mode, or FMC selections while hand-flying the aircraft, rather than asking the Pilot Not Flying (PNF) to make the selections on their behalf. All of these events occurred in the Takeoff/Climb phase of flight, with most occurring just after takeoff and at low altitude.

Table 31: Procedural Sub-Error – PF/PNF Duty

PF/PNF Duty	Frequency
PF makes own MCP/FCU changes	7
PF makes own FMC/FMGC changes	3
Intentional Noncompliance – PF makes own MCP/FCU changes	2
Intentional Noncompliance – PF sets own flight controls or switches	1
Intentional Noncompliance – PNF carried out PF duties	1
z – Other PF/PNF duty error	1
Total	*15*

- *"PF turned the heading bug and selected LNAV while hand flying and with no cross verification."*
- *"The Captain made inputs in the FMS and ADU while he was hand flying. The FO did not challenge him."*
- *"Just after rotation, PF asked for yaw damper to be engaged. PNF selected yaw damp, but nothing happened. The PF then reached up and pushed RESET on the ADU, but the yaw damp would still not engage. The PF continued to hand fly the departure, and the crew resumed trouble-shooting at 5000' and engaged the autopilot. The crew was unsure of what caused the problem, but the autopilot and yaw damper were now engaged."*

Procedural Sub-Error: SOP Cross Verification

While observers coded these errors based on the context in which they watched them occur, the 22 errors in this category were associated with only 4 types of events:

Table 32: Procedural Sub-Error – SOP Cross Verification

SOP Cross Verification	Frequency
Failure to cross–verify FMC/FMGC inputs	10
Failure to cross–verify MCP/FCU/altitude alerter changes	6
Failure to cross–verify altimeter settings	2
Intentional Noncompliance – Failure to cross–verify MCP/FCU/altitude alerter changes	2
Failure to cross–verify clearance	1
Omitted flight mode annunciation	1
Total	*22*

- **Activation/Execution of FMC function:** One pilot single-handedly makes changes to the flight plan in the FMC which affect (or will affect) the flight path of the aircraft. This was frequently associated with an ATC clearance (*"Proceed direct BIRLA direct Winnipeg"*) or when transitioning from enroute to approach by proceeding 'direct' to an approach fix. The other pilot may have been aware of the change without verbalizing it, however there were cases where the other pilot was preoccupied with other duties when the change was made.
- **Confirmation of altitude selection:** The altitude preselector is set to a new altitude, but verbal confirmation is not made to remove any doubt that both pilots are aware of the new selection. Observed in all phases of flight.
- **Flight director/autopilot mode selection/change:** Mode selections done without verbalization. Though both pilots may have been anticipating the selection, there were instances where the other pilot was 'head's down' and otherwise preoccupied and did not observe the selection. In one event, the crew was preoccupied with an approach briefing as the autopilot correctly captured the selected altitude. The crew did not immediately notice the level-off, and therefore did not verbalize the automatic mode changes (ALT); the crew detected the situation just prior to the overspeed warning.
- **Crosscheck on receipt of new altimeter setting:** Crew independently set their own altimeters on receiving a new altimeter setting, though no verbalization or crosscheck. Often the altimeters were correctly set, however in the event described below, an error was made and not immediately trapped by the crew:

  "ATC gave the crew the clearance, "Descend 5000, Winnipeg altimeter 29.77", and once the crew read this back, ATC advised, "fly your present heading, plan the NDB 18". All altimeters were set to the ATIS message of 29.81. While the Captain was reading back the descent clearance to ATC, the FO reset his altimeter to the updated 29.77 setting. The Captain had read back the clearances and set the altitude selector, but did not update his altimeter or the standby altimeter to the new setting. Approximately 3-4 minutes later, ATC gave a descent clearance to another company flight, including the altimeter setting. The Captain then crosschecked his own altimeter and updated to the new (29.77) setting, along with the standby altimeter and announced, "29.77" to which the FO acknowledged, but had already set."

Procedural Sub-Error: Other Procedural

This subcategory is a collection of errors which are not captured in another procedural category. Most are independent and unique, and the more notable events are summarized below:

Table 33: Procedural Sub-Error – Other Procedural

Other Procedural	Frequency
Other procedural error	10
Duties performed at inappropriate time	8
Intentional Noncompliance – Admin duties performed at inappropriate times	6
Intentional Noncompliance – Other procedural error	6
Intentional Noncompliance – Operation with unresolved aircraft malfunction	2
Crew omitted cabin/flight attendant call	1
Intentional Noncompliance – Failure to use proper WX SOP	1
Intentional Noncompliance – Inappropriate taxi–in or out without wing walkers	1
Wrong MEL action performed	1
Total	*36*

- VFR flight in MVFR weather: *"Crew elected to fly VFR to destination with ceilings at 1000 AGL; the aircraft was flying in and out of the bottoms of the clouds during the cruise portion of the flight and had to identify and maintain separation from another aircraft inbound to destination at the same time." (Earlier in this flight, the crew had detected that they had forgotten to turn the TCAS system on)*
- Emergency after takeoff: Crew encountered smoke in the cockpit immediately after takeoff. Memory items and smoke checklist from QRH done prior to acceleration altitude and before aircraft was cleaned up. Crew was challenged to remain organized and checklists were completed out of sequence and at inappropriate times.
- System tests (system not installed): *"Captain performed pre-flight check on a system that was not installed on the aircraft (cargo fire suppression). The FO informed the CA that the system was not installed on the aircraft and that testing the system would not do anything."*
- MEL operational procedure mismanaged: *"The crew forgot to delay the retraction of the landing gear in accordance with the MEL operational procedures associated with the brake temperature monitoring system being unserviceable. The Captain realized their mistake after the gear was already raised. The crew may have been distracted from a previous error where there was a misunderstanding of the ATC clearance just prior to departure."*
- Crew direct CSA to aircraft with engines running: *"Crew directed CSA to approach aircraft with both engines running to deliver paperwork. Passenger forgot Medical Papers in the terminal. Crew taxied back to the terminal and asked agent to pass the papers through the document door. Crew discussed shutting down #1 but agreed they would get a hot start if they did. Crew briefed the ground agent and it was ok with her."*
- Takeoff with APM off: *"While taxiing out, crew got a Master Caution- Icing due to an APM Fault. The FO attempted a quick reset, but was unable to reset it. He asked the Capt if they would like to do the QRH, the Capt said "no, just turn it off". The rest of the flight was conducted with the APM off."*
- Engine start (propeller brake) without marshaller: *"CAPT started "#3" (engine with prop brake ON) without asking if the engine was clear from a marshaller or from the FO. He did not run any checklist until after the engine was started."*

There were however two issues which were logged on multiple flights:

- FO brake test: *"FO did not test his brakes during taxi checklist"; "Brake test not conducted by FO".*
- Admin duties performed at inappropriate time (taxi):
  - *"FO was "head's down" completing paperwork for entire taxi route, beginning on the runway and ending at the gate."*
  - *"Completion of paperwork, and checking cell phone texts while taxiing in."*
  - *"Logbook completed on the taxi; PNF "head's down" for entire taxi route."*
  - *"FO completed logbook on the runway in the backtrack."*
  - *"FO completing paperwork during ground taxi. Did not help in maintaining an active awareness on taxi in."*
  - *"PNF made logbook entries while the aircraft was taxiing on the runway."*

COMMUNICATION ERRORS

Procedural Sub-Error: Pilot to Pilot

Table 34: Communication Sub-Error – Pilot to Pilot

Pilot to Pilot	Frequency
Intentional Noncompliance – Sterile cockpit violation	20
Crew Miscommunication of Information	3
Failure to communicate approach information	3
Total	***26***

Sterile cockpit violations made up over 75% of the errors in this subcategory. Non-essential conversation was noted in all phases of flight at various altitudes below 10,000ft AGL. Crews appeared to manage conversations around radio calls and checklists with mostly inconsequential outcomes, although some crews committed callout errors which were linked. While most sterile cockpit errors were related to conversations, some were associated with non-essential tasks at inappropriate times:

> *"As the aircraft was holding short of the departure runway, a noise could be heard over the intercom. The FO asked if everybody had turned off their cellphones. The Capt responded, "No, I think mine is still on" and then shut his off."*

In one event, the Captain and First Officer appeared to be on 'different pages' with respect to their departure, as described by the observer below:

> *"The crew was issued a HOLD SHORT clearance in their taxi instructions (Runway 13, W-F-P, HOLD SHORT Runway 18). The FO read this clearance back as the aircraft turned out of its parking position. As the crew was taxiing along FOXTROT, the Capt asked the FO about the hold short clearance, "We're supposed to hold on Papa?" The FO confirmed this for him. The Capt then responded, "I guess we're using 13 today". This exchange suggested that neither pilot had discussed the departure runway with the other and both pilots may have been focused on other things as their began the taxi out (Capt taxiing aircraft, FO reading back clearance)."*

Procedural Sub-Error: Crew to External

Table 35: Procedural Sub-Error – Crew to External

Crew to External	Frequency
Misinterpretation of ATC instructions	3
Missed ATC calls	3
Other crew to external communication error	3
Intentional Noncompliance – Other crew to external communication error	2
Crew omitted ATC call	1
Wrong position report	1
Wrong readbacks or callbacks to ATC	1
Total	***14***

Several events were logged where a pilot responded to a similar callsign, or missed a call from ATS. In all of these events, the crew trapped the error, and it was usually the other pilot that detected the error. There were events where there was a mistinterpretation of ATC instructions with no consequential outcome:

> *"ATC gave a speed restriction of "210 or less", The PNF read back "Calm Air XXX, slowing". Several minutes later, the PF asked the PNF if they were supposed to slow to 210kts or less, to which the PNF replied, "No, I think he just said '10 knots less'". ATC subsequently for speed reductions to 170kts, and finally to 150kts or less, which the PF complied with."*

There were others however which were linked to additional flight crew errors:

> *"First Officer wrote down the correct clearance (CYTH-CYWG FPR FL190) but then assumed the Thompson ONE departure was given, which it was not. The captain queried the first officer's understanding of the clearance but then accepted the FO's understanding as correct. LOSA observer told crew to clarify with ATC prior to taking off, at which point it was confirmed the Thompson ONE departure was not given and the correct altitude was selected in the ADU prior to departure."*

Summary

The commission of errors between Captains and First Officers was nearly identical (42% and 41% respectively). Captains were more likely to commit checklist and PF/PNF duty errors, while First Officers were more likely to commit "other procedural" and systems/instrument/radio errors.

Figure K: Error -"Who Caused it?"

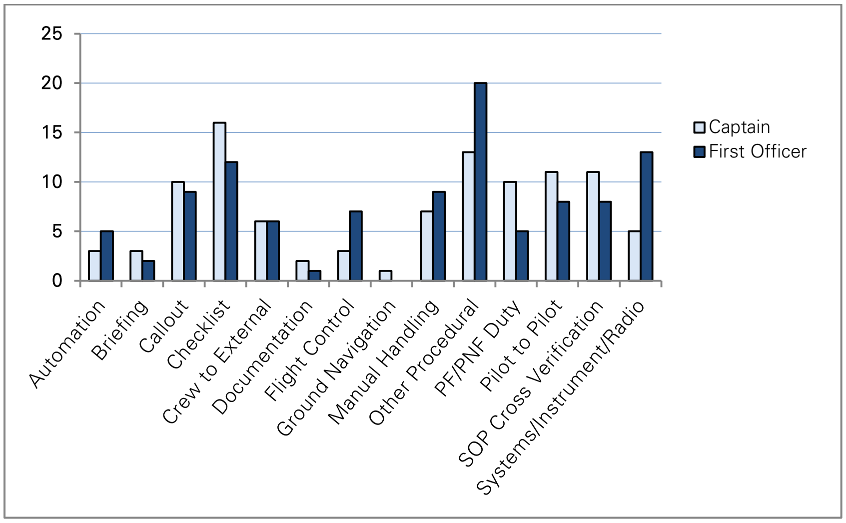
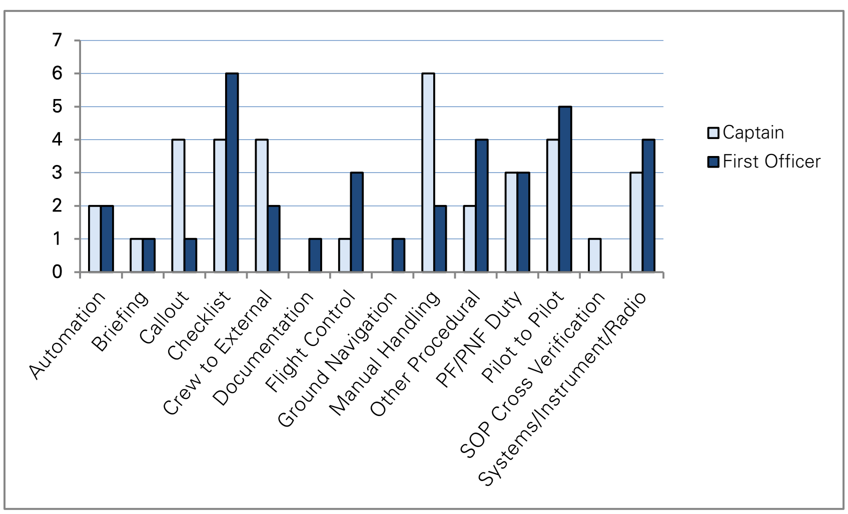


Table 36: Error Descriptives

Error Caused By	Frequency
First Officer	105 (42.3%)
Captain	101 (40.7%)
All Crew Members	35 (14.1%)
Nobody	4 (1.6%)
A/C Systems	2 (0.8%)
Flight Attendant	1 (0.4%)
Total	*248 (100.0%)*
Error Detected By	
Nobody	161 (64.9%)
Captain	35 (14.1%)
First Officer	35 (14.1%)
All Crew Members	10 (4.0%)
LOSA Observer	4 (1.6%)
ATC	2 (0.8%)
A/C Systems	1 (0.4%)
Total	*248 (100.0%)*
Crew Response	
Failed to Respond	169 (68.1%)
Trap	66 (26.6%)
Exacerbate	13 (5.2%)
Total	*248 (100.0%)*
Outcome	
Inconsequential	219 (88.3%)
Undesired Aircraft State	19 (7.7%)
Additional Error	10 (4.0%)
Total	*248 (100.0%)*

With respect to detecting errors that had been made, Captains were more likely to detect callout, crew-to-external communication and manual handling errors. First Officers were more likely to detect checklist, flight control and "other procedural" errors. Of the errors which were logged by observers, the Captain and First Officer detected only 30% of them; 65% of all errors went undetected by the flight crew.

Figure L: Error -"Who Detected it?"

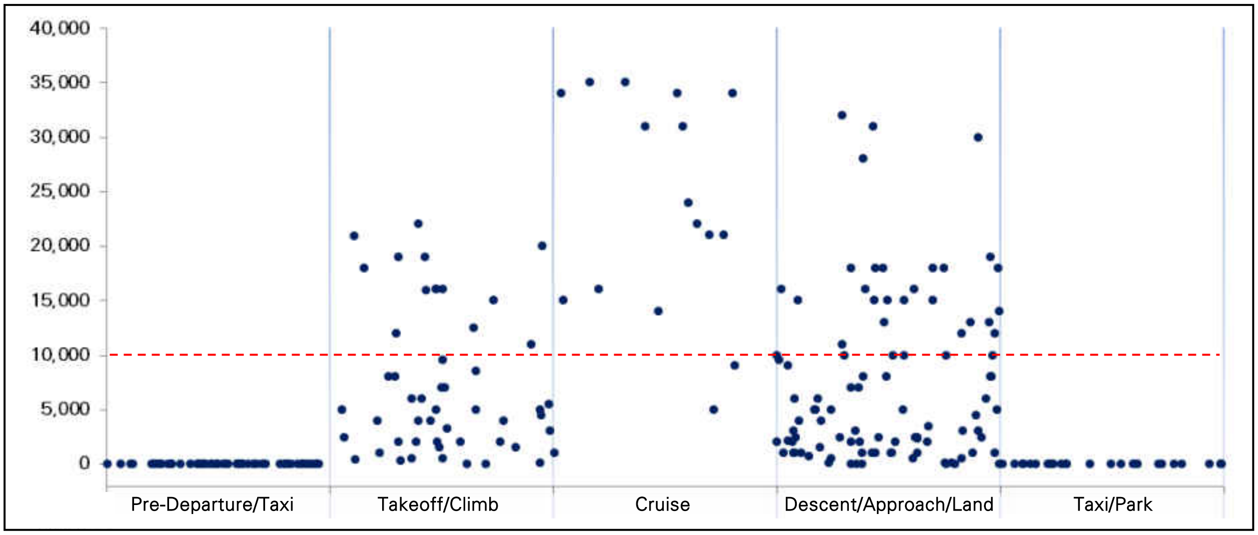


Similarly, flight crews failed to respond to 68% of the errors which were made. This could support the fact that the crew did not detect roughly the same proportion of errors. Crews took action by trapping 27% of errors and exacerbating the situation (making it worse) in 5.0% of errors.

Despite the rates of detection and response by flight crews discussed above, nearly 90% of errors resulted in inconsequential outcomes. Having said this, in 10 cases the crew made an additional error while managing the situation, and in 19 cases, crew action (or inaction) resulted in an undesired aircraft state.

A review of the altitude at which errors occurred reveals the prevalence of errors made at lower altitudes. Much the same as was noted with threats, the vast majority of errors were made below 10,000ft (78%), with (38%) occurring on the ground, suggesting that error commission rates are higher near the beginning and near the end of flights.

Figure M: Error Prevalence by Altitude



UNDESIRED AIRCRAFT STATES

LOSA UAS prevalence and findings are detailed below by phase of flight and tabulated by sub-category.

Table 37: Undesired Aircraft States

UAS Prevalence		Frequency
	Aircraft Handling	96% (22)
	Ground Navigation	0% (0)
	Incorrect A/C Configuration	4% (1)
Total		*100% (23)*

LOSA observers recorded a total of 23 undesired aircraft states over the course of 83 observations, an average of 0.28 UASs per flight (one UAS for every 3 flights). All but 3 undesired aircraft states occurred in the Descent/Approach/Landing phase of flight: there was one UAS associated with an Incorrect Aircraft Configuration and the remainder were all related to Aircraft Handling.

Figure N: UAS Prevalence by Phase of Flight

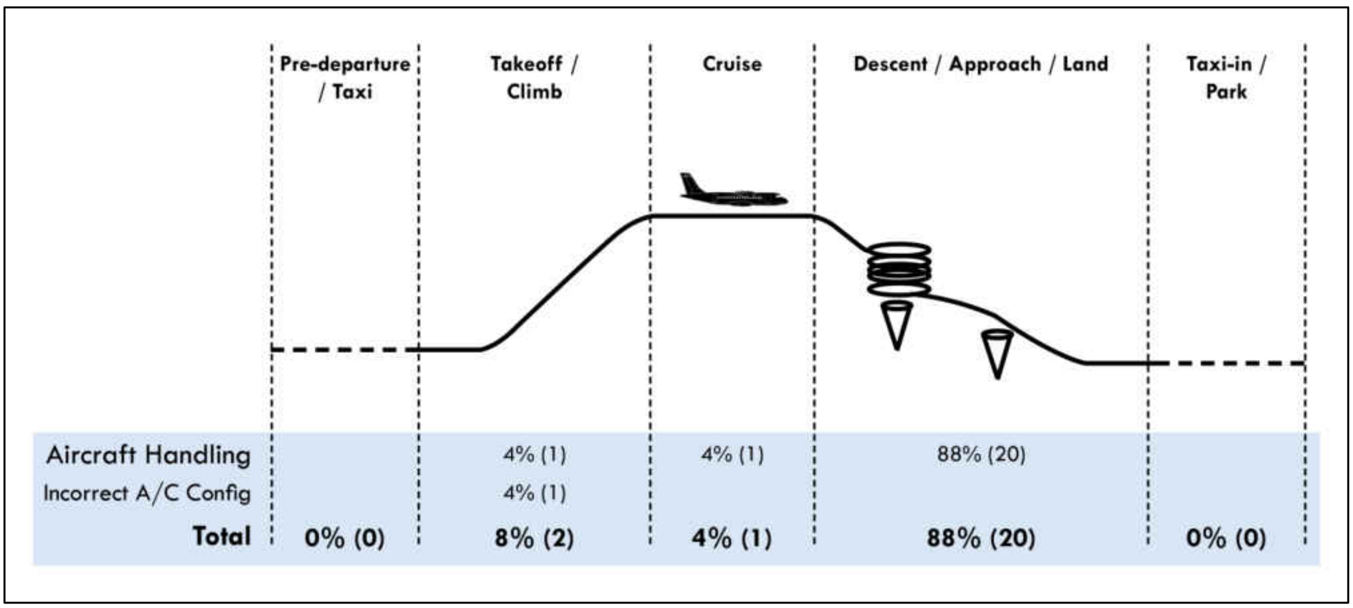
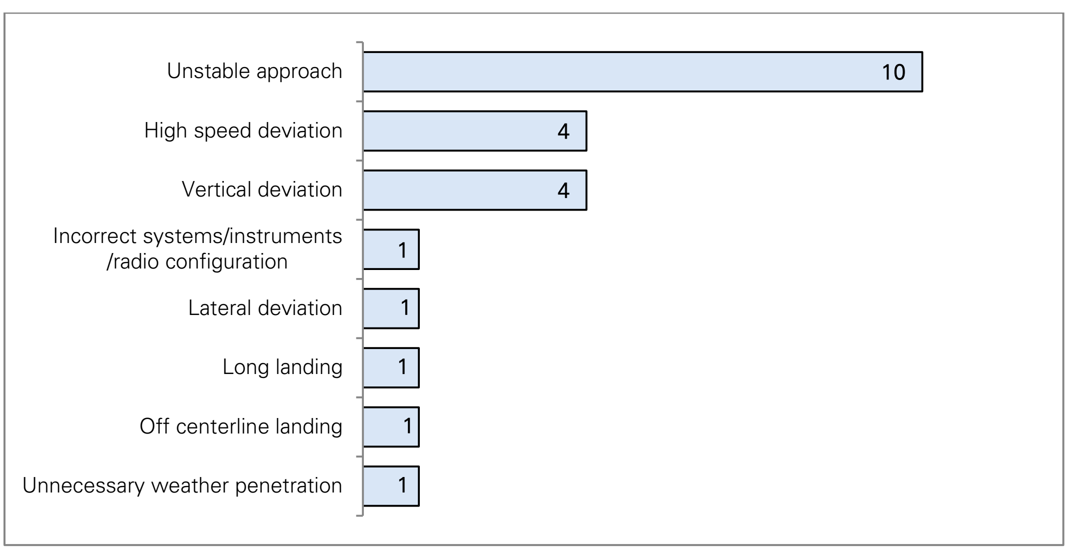


Figure O: Top UAS Bar Graph



UAS Sub-Category: Aircraft Handling

Table 38: UAS Sub-Category – Aircraft Handling

Aircraft Handling	Frequency
Unstable Approach	10
Vertical Deviation	4
High Speed Deviation	4
Lateral Deviation	1
Long Landing	1
Off Centerline Landing	1
Unnecessary Weather Penetration	1
Total	*22*

The most frequent Aircraft Handling UAS observed was unstable approach, which is discussed in more detail below. High Speed and Vertical Deviations were the second most frequent, followed by several events which were only observed once each. Due to the low number and relatively higher risk of undesired aircraft states, each are detailed below.

- *"The crew descended below the 25nm safe altitude and below published procedure turn altitudes and levelled off at 1400 feet ASL (700 feet AGL) approximately 7nm from the airport.*

  The weather in [destination] turned out not to be VFR. It was overcast at approximately 900-1000 feet with good visibility. The crew descended below the 25nm safe altitude and below published procedure turn altitudes and levelled off at 1400 feet ASL (700 feet AGL) approximately 7nm from the airport on the inbound approach track. The GPWS issued a terrain warning as the aircraft approached 1400 feet. The aircraft had broken out of the clouds around 1600 feet and the crew had ground contact at the time of the warning."
- *"Aircraft was significantly above the intended vertical path during the descent, necessitating a descent angle outside of normal operations (4.1 degrees). Crew was able to re-capture the desired vertical path with reverting to a lower level of automation."*
- *"Crew leveled off 400' above desired altitude during climb. As opposed to descending to initial altitude, crew elected to keep climbing to FL110. Uncontrolled airspace, no violation."*
- *"Excess power led to aircraft overspeed clacker detecting the condition. PF reduced power, and shallowed the descent to recover."*
- *"Aircraft high on approach. Aircraft remained "all white" on the PAPIs until short final."*
- *"The tailwind was noted at 10 knots on short final. Flare was initiated at Vref+10 although the aircraft had achieved approach slope by short final. Due to tailwind and fast approach, most of the runway was used. Crew used more reverse and braking than normal."*
- *"The aircraft was briefly oversped through flight level 185 on descent."*
- *"Aircraft banked away from desired flight path when autopilot was engaged. Heading bug wasn't aligned with runway, so aircraft banked once AP was engaged. Crew accepted the deviation and continued."*
- *"VMO overspeed. PF immediately reduced the torque. No verbal response."*
- *"Crew Flew though a CB. The Crew was distracted by the FA, and Approach Briefing. There was no communication between PF and PNF on the ADU changes. All this resulting in the Aircraft flying through a CB creating an unnecessarily bumpy ride."*
- *"PF lost directional control due to incorrect aileron inputs for the cross-wind on the Landing rollout. Captain quickly took control and recovered the aircraft."*
- *"VMO Overspeed protection engaged in descent. PF reduced thrust and corrected the fault."*

UAS Sub-Category: Incorrect Aircraft Configuration

Table 39: UAS Sub-Category – Incorrect Aircraft Configuration

Incorrect Aircraft Configuration	Frequency
Incorrect systems/instruments/radio configuration	1
Total	*1*

During data verification, the steering committee elected to include an event within this sub-category based on the UAS defining criteria which says that a UAS "occurs when the flight crew places the aircraft in a situation of unnecessary risk" and "can also occur as a result of equipment malfunction" (ICAO, 2002, p.2-4).

In this event, the crew received information from the flight crew handing the aircraft over to them about a possible issue with the air conditioning system. Based on the information that they had at the time, and after consulting Maintenance personnel, the crew departed with the anticipation that they would be able to control cabin temperature, however the situation increased risk to the passengers and crew.

"Once airborne the temperature in the cockpit only got hotter. FA was notified of the problem and that crew was unable to control it, the FA was going to monitor it and keep the pilots notified of the situation. Pilots worked with maintenance on the radio and discussed options of what to do; LOSA Observer was asked to contribute as a crew member and assisted in reviewing the QRH, resetting breakers, etc.

FA called to say people were sweating in the back, one passenger was not feeling well due to the heat. At this point the crew decided they could not continue the flight due to health reasons and diverted back to Winnipeg (Approximately 50N of YWG). The cockpit was unbearable at this point, the temp was pegged at 35+ degrees, and switches were hot to the touch. Crew discussed options of cooling the cabin as there are no SOP or QRH direction for this, one bleed was shut off to reduce the hot airflow but maintain pressurization. The crew did a good job maintaining control of the aircraft, the PF directed jobs to the PNF and myself. Considering the situation and extreme heat, everyone focused on the task at hand.

Visual approach was completed and kept in tighter than normal to get the passengers on the ground as quickly as possible and start ventilating the cabin and cockpit of the extreme heat."

Unstable Approach Breakdown

Stabilized approach criteria are published in Standard Operating Procedures for all aircraft types (ATR42/72, Dornier 328JET, Hawker Siddely HS748). Current policy requires states that *"All Calm Air aircraft must be on a stabilized approach profile by 1000 feet AGL and must remain within these parameters until touchdown. Any deviation from a stabilized approach profile MUST result in a missed approach."*

Ten approaches were logged for being outside at least one element of the stabilized approach criteria. Each unstable approach is detailed on the following page. High speed events were the most common deviations observed, and in all but two cases, the approaches were flown in VMC. A go-around was not conducted in any of the events logged.

Table 40: Approaches Outside of Stabilized Approach Criteria

Calm Air Stabilized Approach Criteria	Approaches Outside of Criteria
1. Aircraft is continuously in a normal position to land and only small changes in heading/pitch are required to maintain the correct flight path	2
2. Aircraft speed is not more than VAPP (Vref) + 20KIAS and not less than VAPP (Vref)	5
3. Aircraft is in the correct landing configuration.	1
4. Sink rate is no greater than 1000 fpm, if an approach requires greater than 1000 fpm, a special briefing must be conducted	2
5. Power setting appropriate for the approach configurations.	-
6. All briefings and checklists have been completed	-
7. ILS approaches must be within one dot of the localizer and glideslope.	-
8. On circling approaches wings must be level by 300 feet AGL	-
9. Non-precision approaches must be within 10° of course	-

Figure O: Unstable Approach

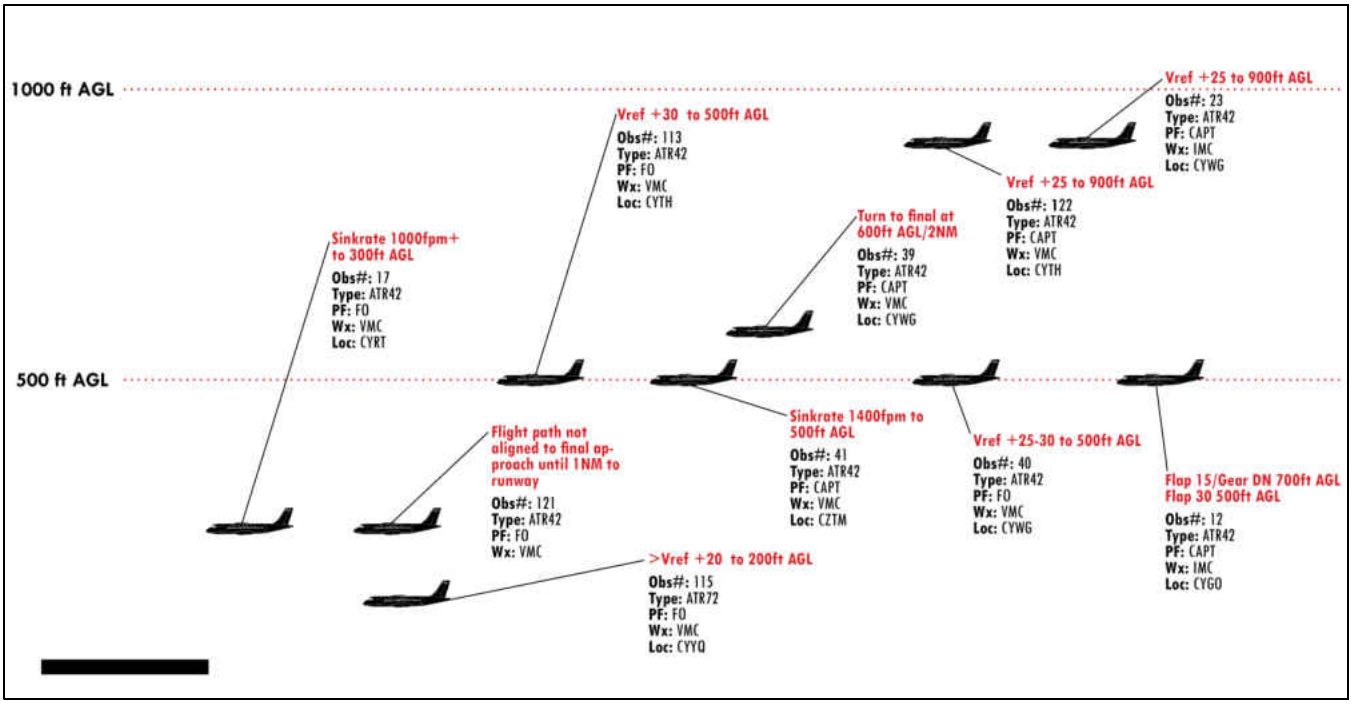


Table 41: Unstable Approach Descriptions

Obs ID	Aircraft Type	Pilot Flying	Recovery Altitude	Observer Description
12	ATR42	Captain	500ft	Crew levelled off at 700 feet AGL without the aircraft being configured to land. The crew continued the approach and did not initiate a go-around. Flaps 15 and gear down were selected approximately 5nm from the airport at 700 feet above ground. Flaps 30 was select 500 feet above ground. Airspeed control was good on the approach once the aircraft was configured. Despite the airspeed control being good, the approach was not stable because of the very late selection of flaps.
17	ATR42	First Officer	300ft	Earlier in the approach, the PNF stated to the PF that *"you better get down your very high"*. The PF selected 1000FPM in the VS select on the autopilot, this was not enough to regain slope, the PF turned off the autopilot and hand flew. Decent rate was about 1400fpm until 1 mile final 300ft AGL. At this time a normal approach was maintained.
23	ATR42	First Officer	900ft	Approach speed was up to VRef+25, but was corrected at 900 feet AGL.
39	ATR42	Captain	600ft	Tight base to final on visual approach Outside of stabilized approach criteria at 600. Crew continued approach to landing.
40	ATR42	First Officer	500ft	Airspeed on approach was in the VRef + 25-30 range between 1000 AGL and 500 AGL, but was within VRef-VRef+20 by 500 AGL.
41	ATR42	Captain	500ft	Descent was flown at high speed. Rate of descent was 1400 fpm down through 1000 ft AGL and was corrected to less than 1000 FPM by 500 ft AGL.
113	ATR42	First Officer	500ft	VRef+30 down until roughly 500' AGL Entered stabilized approach criteria through roughly 500' AGL. Aircraft was a freighter returning empty.
115	ATR42	First Officer	200ft	Aircraft was VRef+45 at 400' // +40 at 300' // +15 at 150'. (ATR72, empty)
121	ATR42	First Officer	300ft	The crew conducted a contact approach in VMC by flying towards the FAF for CYFO RNAV 18. The aircraft passed abeam the airport at Vmo. As the aircraft was approaching the fix at Vmo, the FMS calculated the rate of closure and initiated a turn to final much too early. The ADU was selected to HDG mode to compensate and the aircraft was navigated on final approach directly to the threshold from this early-turn point. This resulted in an approach path that was laterally offset from centerline by 30 degrees. The aircraft was not on centerline until 1NM final. All other criteria for stable approach were met.
122	ATR42	Captain	900ft	The aircraft did not meet stable approach criteria (Vref +20) until 900 feet AGL. The UAS was not detected and the approach continued normally.

Summary

Captains and First Officers were responsible for causing an equal number of undesired aircraft states, and were responsible for an equal proportion of unstable approaches.

Most events went undetected by the flight crew, *as perceived by the LOSA observer*. Considering the number of high speed deviations and lower altitude configurations that make up the unstable approach events, it could be suggested that both pilots were aware and/or comfortable about the condition of the aircraft at that moment; because they took no action, the observer would have logged this as not being detected. Of 10 unstable approaches, only one was detected by the crew.

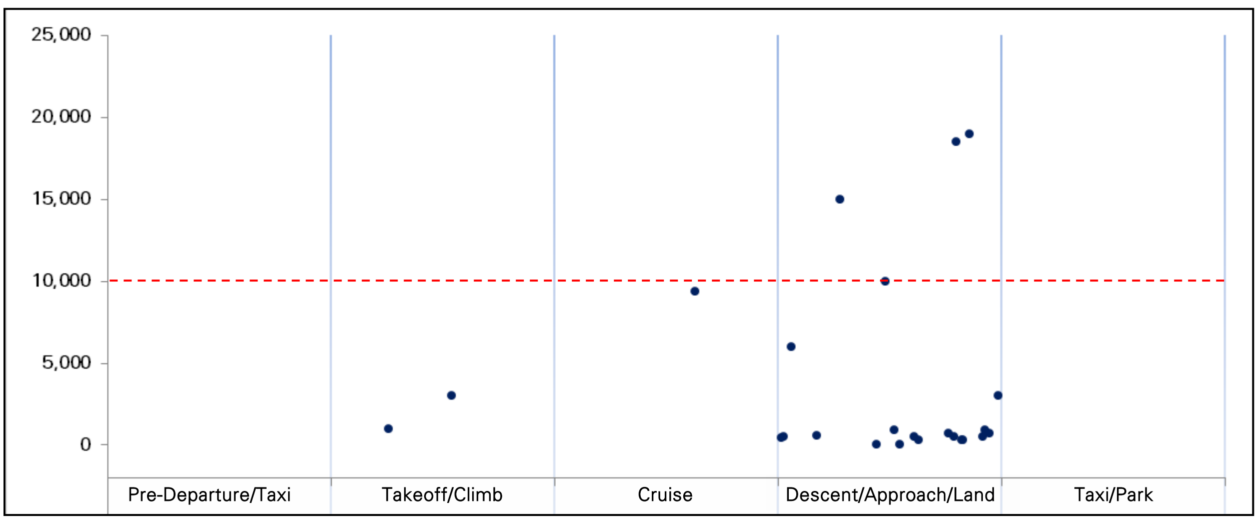
Despite not being detected, most UASs were mitigated by the crew and resulted in recovery.

A review of the altitude at which UASs occurred reveals the prevalence at lower altitudes. Much the same as was noted with threats and errors, the vast majority occurred below 10,000ft (87%), with (70%) occurring below 1000ft AGL.

Table 42: UAS Descriptives

UAS Caused By	Frequency
Captain	10 (44%)
First Officer	11 (48%)
All Crew Members	1 (4%)
A/C Systems	1 (4%)
Total	*23 (100.0%)*
Error Detected By	
Nobody	13 (57%)
Captain	5 (22%)
First Officer	0 (0%)
All Crew Members	4 (17%)
A/C Systems	1 (4%)
Total	*23 (100.0%)*
Crew Response	
Mitigate	17 (74%)
Failed to Respond	6 (26%)
Additional Error	0 (0%)
Total	*23 (100.0%)*
Outcome	
Recovery	18 (78%)
End State/Incident/Accident	5 (22%)
Additional Error	0 (0%)
Total	*23 (100.0%)*

Figure P: UAS Prevalence by Altitude



CREW QUESTIONNAIRE

LOSA observers offered crews the opportunity to respond to a set of questions about the operation. These were normally conducted verbally during a low workload portion of the cruise segment, or on the ground at the end of the flight. Crew responses are offered below as they were recorded by Observers.

Training: Is there a difference in how you were trained and the reality of line operations? If so, why?

- Roughly half of the responses were directed towards training and use of the FMS on the ATR fleet. Some of their comments are quoted below:
    - *"There is very little FMS covered in the training and none in the simulator training."*
    - *"Yes there is a difference because there is no FMS in the simulator. The reality of line operations vs sim training is very different because of this."*
    - *"FMS use in the plane versus none in the sim. Not trained for any FMS use, and especially irregular ops. Sim training seems foreign with heavy emphasis on NDB approaches, but I have yet to do one on the line."*
    - *"The captain was very adamant in stating that the ATR pilots are flying online differently than what is expected (according to regulations) when it comes to approaches in the north. There are many times when full procedure circling approaches should be conducted according to regulations, but a straight in approach using GPS fixes is done instead (since it is considered safer and more efficient). Since the ATR is not certified for GPS approaches (and do not have those approaches in the database), this is not according to the COM or SOPs but is common practice."*
    - *"Why are full procedure approached trained for new FOs in the sim but immediately discouraged during line indoc by line indoc captains? Training does not line up with the reality of line operations. FMS isn't touched during training. The first time a new FO sees the FMS is on line indoc. Use of true heading in NDA is ignored because the aircraft are incapable of satisfactory precession levels."*
- Remarks were made about the way that stalls were described in the SOPs compared to the way that they are trained in the simulator.
- Finally, several crews offered comments about a lack of structure in line indoctrination training, and incomplete exposure to all of Calm Air operations (fuel/freighters/arctic/scheduled pax).

Standardization: How standardized are other crews that you fly with? If there's a lack of standardization, what do you think is (are) the reason(s)?

- Mostly standardized, though there are variations. Some responses alluded that crews can be selectively standardized when they want or need to be.
- As this question was asked to a crew, each member offered their thoughts, which often differed based on their seat. Captains noted that FOs were mostly standardized, while FOs noted that some Captains often have their own procedures or habits for certain situations, such (i.e.; "some Captains call for a checklist, others just expect you to start it"). One Captain suggested that standardization was excellent with junior FOs, but that FOs with more experience often developed their own habits.
- Most crews pointed to SOPs as a key reason for variation in standards.
    - SOPs sometimes too vague, open to interpretation
    - Incorrect, not updated in several years (e.g. APM, PF/PNF responsibilities for ADU [ATR])
    - SIM Instructors train SOPs, then Line Training Captains train to ignore SOPs that don't work in the real world
- Crews also cited certain "quirks" that crews imported from other aircraft types which did not apply to their current aircraft type.

Automation: What are the most significant automation catches (traps) for this aircraft?

- [ATR] *"There is no clear SOP for switching from a HEADING to a NAV situation (i.e.; ATC vectors, then 'cleared on course).(1) some people fly in HDG mode and then arm NAV mode.(2) Some people set up FMS HDG CMD, then arm NAV."*
- [ATR] "*Mode select stuff, when to do it, how to do it properly."*
- [D328] *"As the jet transitions into ASEL, if you move the pitch wheel, auto pilot goes into "PIT" mode and will descend or climb through selected altitude."*
- [ATR] "*PUSDO ILS in dual FMS. PNF/PF confusion over who does what on the ADU, heading bug, course bar. SOP's should be more like the jet where the PF owns the panel when the autopilot is on, and the PNF owns it when the PF is hand flying."*
- [ATR] "*The most significant trap for this aircraft is that people are not being properly trained on the use of the FMS. No real operational training and no FMS training in the simulator (no FMS instrument procedures training device that can be used by crews)."*
- [ATR] "*Different FMS configurations among the fleet. No fleet standardization, and not differences training is provided."*

Overall Safety Improvements?

- Flight Ops
  - Equipment - Crews cited aircraft equipment issues as opportunities for improvement:
    - *"It would be nice to see laser gyros put into the aircraft, EFIS COMP faults are often ignored and will one day cause major issues. Significant terrain and irregular compass readings make for an accident in the making to crews not intimately familiar."*
    - *"RNAV approval. The single greatest safety improvement is sorely overdue."*
    - *"Request made to standardize the center pedestal layout of the ATR fleet to the greatest extent possible. (FMS installed in center for single FMS installations; radios and panels laid out in the same configurations)."*
  - Ground Support – Crews discussed inconsistent availability of marshallers at ground stations, and inconsistent loading of aircraft to the point where it is difficult to open the cockpit door due to bulging cargo nets. Pilots also felt that having to pass along commissary lists over the radio increased their workload near the end of their flights.
  - Resources – Comments were related to how resources were assigned to tasks that they felt was important to the operation.
    - *"Resources! A couple people can only do so much. "Old school" mentality vs. "new school.""*
    - *"Flight Ops does not devote enough resources to the ATR. The Jet program seems to have all the attention when it is only 15% of the company. We need a dedicated manager to take care of the ATR the way that the CP has done for the jet."*
  - Fatigue Management – Many crews responded strongly to this issue. They felt that there was a need to improve the safety culture with respect to fatigue management. This ranged from general staffing levels and high monthly credit averages, suggesting that crews would report to work unfit for duty, to more specific flight duty assignments.
    - *"Flt Ops needs to look at fatigue management with pairings and adding flights at the end of the day to guys. Fatigue is a huge issue at CA, doing max amount of flying with bare minimum crews."*
    - *"Need to stop scheduling crews for 14 hour duty days on paper when everyone knows that the day will never get completed forcing crews to feel the need to extend days, rush, etc, we are doomed from the start."*

- Dispatch – Some crews noted that their interactions with Flight Dispatch were good, and that they were showing improvement. Others cited more specific challenges and areas for improvement:
    - Crews expressed a lack of confidence in their Flight Dispatcher at times, citing high turnover and challenges with quality control. They also expressed an expectation that Flight Dispatch should be "a step ahead of them" when they landed at their next destination with respects to loads, performance planning, weather, etc.
    - Communications: Language barriers with Flight Dispatchers who are not primary English speakers, creating opportunities where things are lost in translation. Also cited communication with other stakeholders, such as cargo and operations coordination where there is sometimes a disconnect (e.g. more Flight Dispatcher input on load control).
- Airport – Crews shared their thoughts on issues related to company operations, airport infrastructure and ATS support.
    - *"There is no one at fishing lodges to provide safe passage to and from the aircraft on the ramp or runway in some cases. I have been there and people are all over the place."*
    - *"LED Airport lights are awesome."*
    - *"Poor CARs hours in the high arctic"*
    - *"More VASI/PAPI in northern Manitoba. Better winter maintenance with CRFI info. More GPS approached if we ever get certified."*
    - *"We need better knowledge of runways conditions, CRFI and RSC would be nice for all airports."*
    - *"There is no weather or altimeters at certain arctic airports on weekends or after hours. How do we conduct our jobs safely?"*
    - *"Northern Manitoba (ie Oxford House, etc) should have current CRFI/RSC (not from the day before). Also, how can Gillam provide CRFI and others cannot? Having more VASIS/PAPIs installed would be helpful. Calm Air should be an advocate for change for these things."*
- Air Traffic Control
    - *"YTH ONE departure needs to be always or never. It causes confusion and is random"*
    - *"In YTH, give us the TH one departure all the time or never. Someone is going to or maybe has busted the departure procedure because it's so random when we get cleared it. Its should be standard like Winnipeg. When cleared flight plan route, crews need to be careful with what dispatch files us (ie. YQD, Ambil, YWG)"*
    - *"A Churchill SID would be nice on IFR days."*
    - *"At or below 15,000' 30nm North of YWG is a restriction that is irregularly applied, tough descent planning, and ATC always gets mad, even though it's not published anywhere."*
    - *"The 50N waypoint from YYQ-YEK is crap. Some operators don't use it, sometimes ATC clears you direct. Just have a procedure with CZWG Centre that YYQ-YEK even altitudes, YEK-YYQ odd altitudes."*
    - *"YYQ 357 50DME transition is dangerous, planes are climbing and descending at one spot with radio changes- AMBIL crossing at 15,000ft or below is often left until the transfer to arrival when its often too late, this should always be given to us."*
    - *"An arrival should be built for approaching Winnipeg from the north. They're always expect 15000' at 30 nm north of Winnipeg but it's not published."*
    - *"Arrival in to YWG to better plan descents and load approaches. Should be using arrivals in to YWG on every leg. Is ATC not aware we can do them? They don't even give it to us when we file them."*
- SOPs
    - Crews offered specific suggestions:
        - [ATR] "*42 checklists need APM Addition of a "line" in initial prestarts and enroute checklist prior to doors and hatches."*
        - [ATR] "*ATR checklists need a review. There are items missing that should be included. Ex: APM is not included in SOPs or in Checklists."*

- [ATR] "*Captain should always advance the power levers, FO's should always set the power as the captain is trying to keep the plane straight on the runway, not looking inside the cockpit*"
- [ATR] "*Stalls/Fire on departure/profile diagrams in the SOPs are wrong.*"
- [ATR] "*"5 Up" calls aren't necessary. No reason AP can't be used below 5,000'*"
- Confusion about application of stabilized approach criteria (IMC vs. VMC, circling)
- Confusion about application of company memos on SOPs

▪ As well as suggestions more general in nature:

- *"SOP's need to reflect what we are really doing on the line, and in training."*
- *"Any amendment since inception has been clerical in nature and with little to no line input!"*
- *"Need a committee (not just office people who may not fly on a regular basis)"*
- *"More amendments. NOTHING has changed in the 5 years I have been on this plane."*

General comments and feedback about the LOSA observation

- The Captain was positive regarding the LOSA experience and his only comment is that he looks forward to the results.
- Crew was optimistic that the LOSA process will improve safety at Calm Air, by identifying higher risk areas of the operation.
- Generally speaking the LOSA was very well received and the crew felt it was a good step forward. They are hoping it will improve safety and efficiency. The FO felt the observations would be biased as everyone would be on their best behavior.
- The Captain does endorse the concept of LOSA but was very upset about the company decision to implement this in the summer during a very busy time when monthly credits are high. The Captain was about to refuse the observation to help prove his point to the company, but changed his mind.
- *"LOSA should not be conducted when all pilots are working crazy amounts, 100+ credits a month, called on most GDO's etc . Good program, happy to see something proactive for a change."*
- *"Eye opening, good program, look forward to seeing the results and final report. Some guys might treat the LOSA as a line check and change the way the fly for the LOSA, because of this results may be off"*
- They both were supportive of the LOSA program, but not happy it was started during a very busy time with high credits for everyone. Also, did mention that at times they may have done things incorrectly just because of the "nervousness" of being watched.
- Crew was positive and supportive of the LOSA. Once crew member feared that some pilots would treat an observation as a line check and be on their best behavior...negating some of the valuable findings that might be out there.
- *"Appreciate the time effort and money the company is putting into this program. Hopefully the company does something with the results, most of the issues have been happening for a long time and management is aware, they were just swept under the rug or ignored in the past."*
- *"good program, it's nice to see something proactive rather than always being reactive. Happy its being done."*
- Possibly could have been conducted at a better time (IE. when crews were less busy)
- *"Need a focused LOSA for freight/fuel hauls. Don't feel that the reality of the work I do is being observed. Lots of threats outside of the normal area of operations. Concerns about one AME working 24hrs in NW Ontario. Potential for fatigue during de-ice, etc...Lack of loadmasters is causing concern about employee injury."*
- The captain and FO were both positive about the observation experience and glad to have an observer on board. They seemed hopeful that the data collected would help out the company.
- *"This is my 4th observation"* (FO)
- The crew felt that LOSA was a positive addition to our company, and were looking forward to the results.

- Overall perception of the LOSA is good. Crews welcomed it and were eager to see the results. They had nothing more to add.
- Pleasant experience and hope good data can be captured. Doubtful that the data will be acted upon by senior management.
- *"We are skeptical that the company will effect actual change based on this LOSA program but we hope the managers make actual change to improve everything.:*
- *"Why not do LOSA on Hawker, bulk fuel, or others types of flights instead of mostly scheduled flights?"*
- *"I think LOSA is a good idea."*
- *"great program, sad to hear guys are getting turned down from some flights, hopefully CA does something with the results."*

DISCUSSION

This section of the report offers discussion on some of the trends that were found in the data.

Comparisons by Aircraft Type

The sampling plan attempted to capture observations from each aircraft type in proportion with the number of annual flying hours of each type, and was a logistical limitation of the LOSA. Because of this, fleet summary information is provided in Table 43 as advisory information only, and the bottom 'CAV Fleet' line reflects the normalized Calm Air data across all types.

Table 43: LOSA TEM Fleet Summary

Fleet	Threat	Error	UAS	Threat Frequency (per sector)	Error Frequency (per sector)	UAS Frequency (per sector)
ATR42 (51 Obs)	109	144	16	2.14	2.83	0.31
ATR72 (15 Obs)	31	61	4	2.07	4.07	0.27
Dornier 328JET (17 Obs)	44	43	3	2.59	2.53	0.18
CAV Fleet (83 Obs)	184	248	23	2.22	2.99	0.28

While making comparisons between fleet types is not statistically appropriate due to the low sample size, a meaningful variation of events between aircraft types was not observed; that is to say that the events appeared to occur in roughly the same proportion regardless of the aircraft type. While the error rate for the ATR72 appears higher than the ATR42 and D328JET, the number of observations (15) is too few to suggest that those errors did not simply occur by random chance. Having said this, it is worthy to ask ourselves whether crews are more likely to commit errors while flying the ATR72 given that crews are rated on both that ATR42 and ATR72, that the ATR72 was introduced to the fleet 5 years after the introduction of the ATR42, that the ATR72 accounts for less than half of the total ATR fleet (2 aircraft dedicated to freighter ops) and that most crews likely fly the ATR42 more frequently than the ATR72. Again, statistically we cannot say that more errors were observed in this LOSA, though it could be indicative of a trend.

Visual Approach Briefings

Current SOP for ATR42 and ATR72 is that an approach briefing is required *"any time that a visual approach is not assured"*. SOP for the D328JET was amended shortly after introduction of the aircraft to the fleet requiring that an AMORTS-style approach briefing is required for all approaches, VMC or IMC.

Briefing errors were noted in some detail in the Error section of this report (see p.26), and noted that crews often abbreviated briefings in visual conditions. The discussion also cited the high prevalence of visual conditions on approach, and the high frequency of Captain/First Officer having flown together before. This high degree of familiarity with the crew, the conditions and the airport likely supports the crew's habits to abbreviate approach briefings down to "VFR for 24" or "the visual, backed up by the ILS". Having said this, in reviewing the unstable approaches within the sample one might wonder if both pilots understood completely how the other was planning the flight path of the aircraft, speeds and configuration changes, runway exit point, etc. Greater detail may have driven the PNF to speak up when his/her mental model of the approach no longer matched the aircraft's position, path or configuration, prompting corrections or a go-around by the PF.

Approach Briefings & Descent Checklist

Observers noted that slightly more than half (58%) of crews conducted their approach briefing prior to the top-of-descent (TOD). Previous LOSA studies (Sumwalt, Thomas, & Dismukes, 2002) have found that crews who brief *after* the TOD commit 60% more errors during the descent/approach/landing phase than their counterparts. In the CAV LOSA, we found only a 13% increase in errors during the same phase if the crew briefed *after* the TOD. When considering this figure it should also be worth noting that crews conducted approaches in VMC conditions 83% of the time and flew a visual approach 74% of the time. The error rate may have been higher if more non-precision or precision approaches were flown in IMC conditions, such as would be prominent during certain times of year in our area of operations.

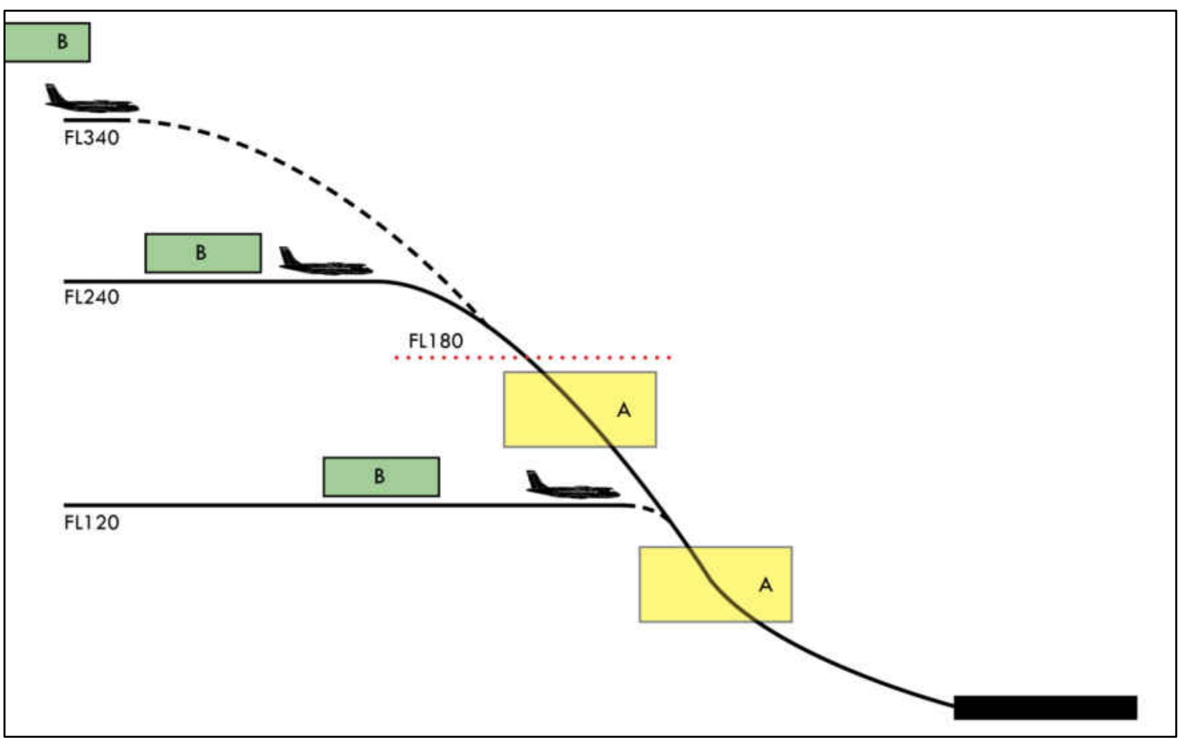
An interesting theme developed when comparing the Observer's narratives of the Descent/Approach/Landing phase which suggests multiple interpretations of approach briefing practices and checklist use.

Fleet SOPs provide expectations for the contents of IFR approach briefings, though they do not explicitly discuss at what point in the flight they should be completed. On each aircraft type, initiation of the Descent Checklist occurs when crossing through 18,000ft in the descent. The final checklist item on the ATR fleet (3rd final on the D328) is *"APPROACH BRIEFING.....COMPLETE"*.

Observers noted that some crews anticipated higher workload in the descent phase, and elected to brief the approach during cruise, nearing the TOD while their workload was still low. In these cases, when the crew reached "APPROACH BRIEFING" in the Descent Checklist, the PF stated "COMPLETE" as to indicate that it had been completed. Other crews conducted their approach briefing when directed to by the checklist; that is, when they reached "APPROACH BRIEFING", they would "COMPLETE" it at that point.

An approach briefing is a common task required by the PF and is routinely completed in less than 2 minutes. During the descent phase, aircraft are generally descending at rates be 2000-2500 feet per minute, suggesting that while the PF is completing an approach briefing, the aircraft can descent through up to 4000-5000 feet of airspace. The task becomes more complex when it is interrupted by ATC instructions, interphone calls from the Flight Attendant, or aircraft navigation tasks, which may occur with greater frequency at lower altitudes.

Figure Q: Approach Briefing Windows



This scenario is illustrated in Figure Q, which depicts an aircraft cruising at FL240. A profile for an aircraft cruising at FL340 (D328), as well as a profile for an aircraft at FL120 (ATR42 in Northern Domestic Airspace) have been included as well. The latter reflects a particular challenge, as the checklist is only initiated at TOD 11,000 feet AGL in most areas, where the checklist and approach briefing can take up a meaningful amount of altitude. The regions where approach briefings were being conducted as a checklist 'DO' item are displayed by 'A'. While it is not against company policy to complete the briefings in these areas, and while LOSA did not reflect significantly higher error rates when they were conducted here, lower risk regions displayed by 'B' represent low workload areas where many crews (58%) elected to conduct their briefings.

While in no case was this briefing practice logged as an error, it did bring attention to the multiple interpretations of the Descent Checklist. This is an area worthy of further review.

Intentional Noncompliance Errors

Knowledge of areas of intentional noncompliance is valuable because it can help to assess the degree of procedural drift in the operation and the areas where it occurs. A better understanding can help identify weak or misunderstood procedures, or areas where crews have truly found a better way to accomplish a task. It may also identify a normalization of deviance, where the norm has drifted over time for any number of reasons, to the to the point that crews are being exposed to risks through to be mitigated. Industry data has shown that on flights without intentional noncompliance errors, the crew see 2.1 errors per flight. On flights where the crew commits a single act of intentional noncompliance, the error rate climbs to 3.9 per flight, and where there are two or more acts of intentional noncompliance, the error rate jumps to 7.5 per flight (Werfelman, 2013).

The LOSA Collaborative is a private organization which supports airlines completing LOSAs by conducting much of the data management and analysis. The organization's founder was one of the original developers of LOSA at the University of Texas in the 1990s. As a result of many years collecting de-identified data, their robust database contains more than 20,000 observations from more than 70 airlines around the world (Werfelman, 2013) and allows for comparison against the airlines (collectively) which have also completed LOSAs. Some of this data has been made public through various industry publications.

A comparison below is made between common intentional noncompliance errors found in the LOSA Collaborative's archive, and the top 5 intentional noncompliance errors logged in the Calm Air LOSA.

Table 44: Common LOSA Intentional Noncompliance Errors

LOSA Collaborative Archive (Werfelman, 2013)	Calm Air LOSA 2014 (Top 5)
▪ Omitted Altitude Callouts	1. Sterile Cockpit Violation
▪ Checklist Performed from Memory	2. Checklist Performed from Memory
▪ Failure to Execute a Mandatory Missed Approach	3. Admin Duties Performed at Inappropriate Times
▪ PF Making Flight Guidance Changes while Hand Flying	4. Self-Initiated Checklist
▪ Taxi Duties Performed While Aircraft is Still on Runway	5. PF Makes Own MCP/FCU changes

Greater awareness among crews of intentional noncompliance zones in their normal flight routines, along with more targeted enforcement during flight training and line checks could lead to more disciplined flight deck compliance.

Checklist & Briefing Interruptions

A great value of the LOSA process has been the ability to identify sequences of events which present risk to a situation which had appeared to be normally benign or irrelevant. All Observers were active, line-qualified pilots who likely did not necessarily see the situation as a threat from their *crew* seat in the moment, but from the jumpseat and free from cockpit tasks could readily identify it as a threat.

Crews dealt routinely with the interruption of a checklist or a briefing while in the Pre-Departure/Taxi phase, and frequently at uncontrolled airports. There were often two interruptions: one when FSS would radio the crew with their IFR clearance, and one when the Flight Attendant called the crew to advise *"Cabin Secure"*.

The sequence of events for crews who commonly do multiple legs per day in and out of uncontrolled airports is very familiar to them. From the LOSA narratives, there is a sense that crews are primarily focused on the tasks to be completed internally (inside the cockpit) and less on the tasks to be completed externally (ATC & cabin). This is appropriate, however crews were often quick to break from their task/checklist/briefing to respond *immediately* to a call from FSS Radio or the Flight Attendant which could have waited until the checklist was completed. In most cases, FSS used the same phraseology, *"Calm Air XXX, clearance when ready…"*, indicating that the crew could respond at their convenience. As was documented in the Threat and Error sections of this report, crews responded to these interruptions in different ways; some re-ran checklists, while others finished off the Captain's briefings or continued from where they left off.

Observer narratives also noted that there were times when both calls came within seconds of each other. In one case, the First Officer stopped the checklist and answered the radio call to accept a clearance. While the FO was writing the clearance, the Captain began dialing up the altitude preselector to the clearance altitude that he overheard on the radio. While the Captain was doing this, the intercom aural alert went off and the Captain responded to the FA's *"Cabin Secure"* call. This all occurred within about 20 seconds, and the FO picked up the checklist and resumed from where he had left off.

The crew on this particular flight did not make any errors, however the threats they encountered presented opportunities to misinterpret a clearance and not have it trapped by the other pilot or mis-set switches or systems due to an omitted checklist item. It is very difficult for FSS or the Flight Attendant to know if they are interrupting with a call to the flight crew, however the flight crew has the ability to defer/delay response if they are already engaged with an important task. Recognition of a crew's vulnerability in this phase of flight is valuable, and more conscious pacing of tasks in anticipation of these interruptions could be encouraged.

Low Error Detection Rates, High Failure to Respond Rates

At first glance, the fact that 65% of errors went undetected by the Flight Crew may appear alarming. This rate reflects what the Observer group logged based on the context of the situation, and it is quite possible that the crew did not perceive their action/inaction as an error.

As an example, a PF is hand-flying the aircraft and is at the same time making entries into the FMC; the PNF watches the PF make these selections, is aware of what is happening and does not intervene. The event happened, both pilots were aware, and because there was no negative outcome or additional error, the PNF felt no need to speak up. In this situation, the event would have been logged as a crew error to which the crew failed to respond.

Similarly, a crew encounters a Master Caution – EFIS COMP (HDG) on the ATR. The crew is familiar with this caution as it commonly occurs, and the PNF pushes the 'Master Caution' button to silence the warning and the flight carries on as normal. The PNF does not annunciate the reason for the alert, the crew does not reference the QRH checklist associated with the fault. Due to conditioning and a normalization of deviance, the crew likely did not interpret this as an issue. Again, the Observer would have logged this as a crew error to which the crew failed to respond.

LOSA categorizes an error as "an error" and treats an incorrectly set minimum descent altitude the same as a missed callout; severity is not considered. When given the context above, it's understandable that at 65% undetected error rate is possible given flight crew norms and 'SOP creep'. This may be supported by the 68% "failed to respond" crew response to errors – the crew did not perceive the event to be an error, and therefore they did not respond to it as an error by attempting to trap it.

This should not suggest that this trend should be accepted by flight crews or the organization, but provides a context as to why these rates may be as high as they are. Efforts to clear up guidance to crews through SOPs and training events, as well as enforcement by Line Training Captains may see these rates reduce in tandem.

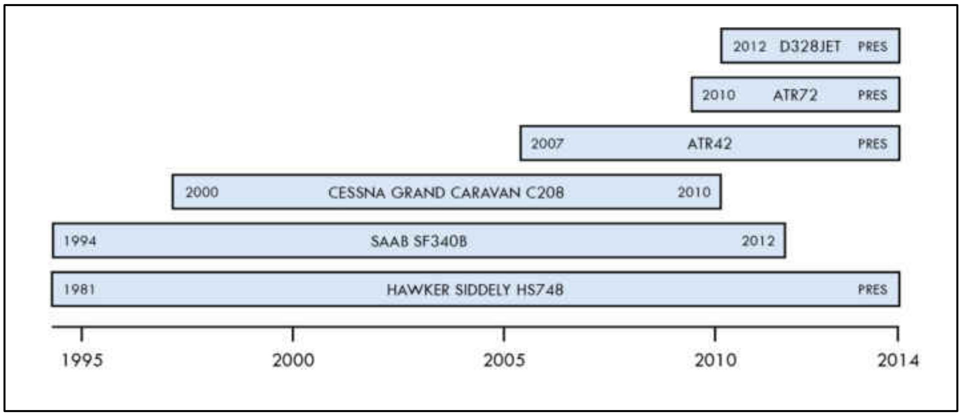
Weaknesses within Fleet SOPs

Crews responded strongly in the Crew Questionnaire when asked about SOPs. Similarly, the Steering Committee was left with several pages of notes at the end of the data verification process – these were notes from Observer narratives which identified SOP weaknesses, issues not accounted for, or guidance which was unclear. Further, they were situations where risk was elevated, but could not be attributed to any crew error. In this sense, a secondary outcome of the LOSA was a meaningful audit of the SOPs.

There were, however, numerous events where crews made callout, cross verification or PF/PNF duty errors where specific guidance exists in company documentation and is trained at training events. It is possible to relate to a crew's sense of familiarity with the operation, the aircraft, and in particular, the other pilots in the company. Depending on their positions in the seniority lists, many pilots see *a lot* of each other, and some (Bulk Fuel Pilots) are crewed together constantly. This familiarity can be an asset in one situation (communication, assertiveness) and can be a threat in another (complacency). Situations were observed where the PF was making entries in the FMC and hand-flying at the same time rather than asking the PNF to make the entry, where a new altitude is set in the preselector but is not confirmed by both pilots, or the altitude callouts are not made on approach. In most cases, there was a sense that both pilots were entirely aware of what was happening and safety was never compromised.

In reviewing the crew data for this report, a relevant trend emerges. Of the 90 pilots on staff at the time of the LOSA, 70% had more than 5 years of service, and many have more than 10 years of service. In the last 10 years, the company has seen a reduction of the Hawker Siddely 748 fleet, the introduction of the ATR42 and subsequently the ATR72 fleets, the rapid retirement of the Saab 340 fleet, and introduction of the Dornier 328Jet.

Figure R: Calm Air Fleet History (2014)



It is worthwhile to note that most pilots, and certainly most Captains, have experience on another aircraft type within the company. It should not be surprising that crews may revert to previous procedures or callouts of their previous aircraft, particularly if this was the first aircraft that they trained on when coming to the company – these would be familiar and habitual. If you combine this with areas where SOPs are silent on an issue or there is vague or unclear procedure, the "*SOP creep*" will begin and relocate to a 'new' normal where others begin to adopt the deviation as their own habit.

While this may not be a serious issue for some crews, it can present a challenge for pilots who are new to the company. Having been trained in the flight simulator away from the operation under the guidance of an instructor who's role it is to display and encourage SOP compliance and discipline, they are thrown an unexpected curve ball at a critical moment on landing when their Captain on the flight line calls *"your pole"* (SAAB 340) rather than the call *"my aircraft"* (ATR42) like they were trained and were expecting to hear. Many pilots likely recognize the deviation in their flying partner, though they may feel that addressing it will come at a cost to crew cohesiveness and opt not to.

The callout, and cross-verification errors and the Crew Questionnaire responses earlier in this report support the trend. SOP improvements are required in these areas, and particularly in the area of PF/PNF duties with respect to automation management. Improvement in this area will require both timely and careful amendment to SOPs for clarity and application, followed by acceptance and disciplined, diligent use by Flight Crews on the line at every level.

Unstable Approach Rate

Unstable approaches are currently an industry hot-topic due to their connection with approach and landing accidents such as controlled flight into terrain (CFIT) and runway excursions, which account for 33% of all accidents (Flight Safety Foundation, 2009). Unstable approaches are identified as the highest risk factor with respect to a runway excursion (Burin, 2011).

Of particular concern to the industry and the source of recent research (Smith, Jameson, & Curtis, 2013) is the willingness of a crew to abandon their approach when outside of the published criteria and conduct a go around. The Flight Safety Foundation notes that the industry's rate of unstable approaches is roughly 3.5% to 4%; for every 100 approaches flown, 3-4 are flown outside of stabilized approach criteria. Furthermore, of all unstable approaches, 97% are flown to a landing; in only 3% of unstable approaches are pilots conducting go-arounds, despite guidance to do so. Smith, Jameson & Curtis (2013) relate the significance of these stats:

> *"It can be argued, therefore, that the almost complete failure to call go-arounds as a preventive mitigation of the risk of continuing to fly approaches that are unstable constitutes the number one cause of runway excursions, and therefore of approach and landing accidents. If our go-around policies were effective even 50 percent of the time, the industry accident rate would be reduced 10 to 18 percent. There is no other single decision, or procedure, beyond calling the go-around according to SOPs that could have as significant an effect in reducing our accident rate."*

This LOSA observed 83 sectors over 10 weeks and logged 10 unstable approaches (UAs): Calm Air flew more than 4500 sectors during the same period. This would put the LOSA UA rate was 12%. Statistically, our sample wasn't large enough to say this with confidence, but it would relate to approximately 542 unstable approaches over that 10 week period (2800 per year).

Having said that, all approaches were logged based on the Calm Air policy that stabilized approach criteria must be met by 1000 feet AGL in IMC or VMC conditions. If we were to apply the traditional Flight Safety Foundation stabilized approach criteria (1000ft AGL IMC, 500ft AGL VMC) we would only consider 5 of these approaches to have been unstable. That's a 6% rate within LOSA observations and potentially 325 unstable approaches during the LOSA period (1690 per year).

Table 45: Unstable Approach Rates

	Industry (AeroSafety World)	Calm Air LOSA 2014
Percentage of ALL Approaches Flown Outside of SA Criteria	3-4%	6-12% (estimate)
Percentage of Unstable Approaches where a Go-Around was Initiated	3%	0%

Based on LOSA data, there is some degree of assurance that Calm Air falls within the industry norms with respect to unstable approaches. It is difficult to make this type of claim based on only 83 observations when many factors may influence an approach, such as the weather conditions, the time of day, or ATC influence. A Flight Operations Quality Assurance (FOQA) program with de-identified flight parameters regularly downloaded to a database directly from the aircraft would be helpful in achieving a higher level of safety assurance on this important issue.

Communications with Other Departments

LOSA provided individual narratives of flight sectors involving different crews, different aircraft and different routes, but collectively, they offered insight into how the operation runs, and how the different mechanisms of the organization operate together when they need to.

The working relationship between Flight Crews and Maintenance Personnel was highlighted in several instances during the LOSA, and one event in particular sheds light on the issue. A crew arrived with an aircraft with a technical issue, and shared it verbally with the crew taking over the aircraft, rather than documenting it in the journey logbook or contacting Maintenance for guidance or troubleshooting. The incoming crew elected to contact Maintenance about the issue prior to departure, and an Engineer drove over to the airport terminal to assess the situation. The outcome was that the Engineer could not definitively diagnose the issue and would have to pull the aircraft offline and replace the unit, citing the downtime required and the cost of the part. The crew was left with that information to make a decision about taking the aircraft, which they did.

The tone of the event reflects a strained working relationship: the flight crew may not want to 'bother' Maintenance for seemingly small or intermittent issues, and a Maintenance Engineer is being asked to assess an aircraft during a short window between flights with the outcome that they may have to take the aircraft out of service for a lengthy period to do so, impacting the flight schedule and passengers. While there may be no management level pressure to maintain schedule at the expense of aircraft serviceability, Flight Crews and Maintenance Engineers may be shouldering that pressure as implied expectations, and end up taking it out on each other. Efforts by the organization to communicate and understand each other's roles and responsibilities, that Crews are required to write up defects in the journey logbook, and that Engineers are required to assess and address aircraft defects free from operational pressures, may improve this working relationship.

Another working relationship which was observed was that between Flight Crews and Flight Dispatchers & Flight Operations Coordinators who work within the Calm Air System Operations Coordination Centre (SOCC). Crew Questionnaire responses revealed that Flight Crews were critical of Flight Dispatchers with respect to their expectations of Flight Dispatch. The Threat section of this report details several instances of flight planning errors. Having said this, there were also instances where the crew was surprised by their flight planned routing, though only detecting the issue once they received their clearance from ATC, suggesting that the route was on their operational flight plan, but was not detected. This would suggest that a review of briefing requirements/procedures/standards between Flight Crews and Flight Dispatchers may be beneficial, particularly when so much information is available to both parties, and most communication is done electronically (email).

Finally, a single observation in the dataset which captured the outbound and return sectors of a charter flight could act as a case study of weaknesses in non-standard trip preparation. Crews encountered issues with crew scheduling (reporting time), lack of familiarity with the destination airport's approaches and ATS hours of operation, were unclear about where to park and deliver passengers at the airport, and were challenged when the flight was assigned an RNAV arrival procedure back into Winnipeg and attempted to enter this information into the FMC. The narratives suggest that while Crews and Dispatchers may be very comfortable with operating within the normal area of operations, higher levels of briefing, preparation and awareness among all stakeholders would lead to better commercial and safety outcomes on these types of flights.

RECOMMENDATIONS

The following recommendations are offered as opportunities for improvement based on the analysis of LOSA data. They are written intentionally broad in scope to allow for more thoughtful implementation within the organization.

1. **Establish a "Standards Committee" for each aircraft type.** Creating small teams that represent the flight crews operating that aircraft type will allow for more a formal evaluation and vetting process for amendments to SOPs and training programs before they are published to line crews. A set meeting schedule over the course of the year would allow for a more systematic and cyclical process for updating documents and incorporating feedback and suggestions from pilots who operate the aircraft. This also creates an environment for better conceived policies and procedures as well as improved buy-in on the flight line.
2. **Research the feasibility and implementation of a Flight Operations Quality Assurance (FOQA) program.** FOQA (often also referred to as Flight Data Monitoring (FDM)) uses de-identified digital flight data that is downloaded from fleet aircraft to a database daily basis, and can be analyzed for trends and abnormal events. The program requires technical and equipment investments in the aircraft fleet, data collection, storage and analysis tools along with a formalized process with the pilot association for use. The value of the program is that it offers objective, aggregate data about how aircraft are being flown, which can offer a predictive safety component to the organization's safety tools in addition to reactive and proactive safety processes.
3. **Review company stabilized approach criteria.** Recent research on the reasons for pilots continuing unstable approaches to a landing has offered insights into how organizations can establish stabilized approach criteria related to their aircraft, operations and environment in an effort to mitigate risk. There were no go-arounds initiated in the 10 unstable approaches observed in the Calm Air LOSA. A review of company criteria may result in redefining risks (resulting in fewer approaches categorized as unstable) and a more clear process for the PF/PNF to trigger a go around when criteria is not met.
4. **Review guidance for completing visual approach briefings.** While instrument approach briefing expectations are quite clear and well-practiced by flight crews, a similarly clear expectation for visual approaches would lead to more comprehensive understanding between pilots in the cockpit. Suggested briefing formats may come from some of the pilots on the line who conduct these already as a personal 'best practice'.
5. **Consider the syllabus and content of a "Captain Upgrade" course.** An 'Upgrade' or 'Command' course can offer a more formalized introduction to organizational systems and expectations that Captains interact with. Traditionally, this familiarization has been accomplished through line indoctrination alone. Captains who are required to make decisions on behalf of the organization while out in the field deserve to have the best understanding about the reasoning behind policies and procedures and how operational functions (i.e.; Flight Dispatch, Flight Operations Coordination) and commercial efforts (i.e.; cargo) integrate into daily operations. A more formalized process of the above could help equip line Captains to be leaders by example at the highest levels.
6. **Explore the capability to standardize ATR fleet cockpit layout to the greatest extent possible.** Because each aircraft in the fleet did not come to Calm Air directly from the manufacturer, most aircraft have minor variations to the arrangement and layout of equipment in the center pedestal due to service with previous operators. There are multiple arrangements of radio heads, FMCs, weather radar controls, etc which makes familiarity difficult, particularly in low light or in abnormal/emergency conditions. It is recognized that in certain cases, re-arrangement may not be practical or possible, however there may be an opportunity to re-arrange and standardize to a more common layout over time. This should be explored for feasibility.
7. **Expedite the authorization of RNAV approach procedures and training for ATR aircraft.** The value of this effort from an operational and a safety perspective cannot be over emphasized, and there is little argument from any stakeholder to that effect.
8. **Identify efforts to improve the working relationship with Maintenance Engineers.** There are numerous factors which can affect this relationship, such as opportunities for face-to-face contact, understanding of the other person's roles, responsibilities and priorities, and certainly personality. A recognition of the points where Pilots and Engineers come in to contact is important. Opportunities for joint training or 'exchange' visits (see Captain Upgrade course above) could be opportunities to accomplish this.
9. **Review processes involved for ad-hoc charter planning.** There is an opportunity to formalize the planning and execution of non-standard flights which operate outside of the normal area of company operations. These should extend beyond charter flights and also apply to freighter and position flights. Recognition of the ways in which these flights are different – airspace, geography, weather, performance, communications, flight watch, ground support are key to assessing and mitigating risks to safety and compromises to customer expectations.

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APPENDIX A – OBSERVER WORKSHEETS

CalmAir

LOSA Observation Worksheet

Observer Information

Observer ID		Observation #	
Crew Observation Number (e.g. "1 of 2" indicates one for a crew that you observed over two segments.)		of	

Flight Demographics

City Pairs (e.g. YYQ-YRT)		
A/C Type (e.g. ATR42)		
Pilot Flying (Check one)	☐ CAPTAIN	☐ FIRST OFFICER

Time from Pushback to Gate Arrival (Flight Time – Hours:Minutes)		Local Arrival Time (Use 24 Hour Time)	

Late Departure?	☐ YES	☐ NO

Crew Familiarity (Check one)

First time the P1 and P2 have ever flown together.	☐
The P1 and P2 have flown together before.	☐

Crew Data

~~Crew Ages~~ (estimated)	CAPT	99	FO	99
Crew Total Flying Experience (estimated hours)	CAPT		FO	
Crew Experience in Type (estimated hours)	CAPT		FO	
~~Years in Automated Aircraft~~ ("glass cockpit")	CAPT	99	FO	99

Flight Deck Climate

Please rate on a scale of 1-5 how strongly you agree or disagree or agree with the following statement by placing a check mark in the appropriate box. Remember to also provide a description in your narrative of why you rated the climate as such.

The observed climate on this sector was functional.

Strongly Disagree 1☐ 2☐ 3☐ 4☐ 5☐ Strongly Agree

Crew Performance Marker Worksheet

1	2	3	4
Poor	Marginal	Good	Outstanding
Observed performance had safety implications	Observed performance was adequate but needs improvement	Observed performance was effective	Observed performance was truly noteworthy

		Phase of Flight Ratings		
PLANNING Performance Markers		Pre-departure/Taxi	Takeoff / Climb/Cruise	Descent/Approach Land/Taxi
SOP BRIEFING	The required briefing was interactive and operationally thorough			
PLANS STATED	Operational plans and decisions we communicated and acknowledged			
CONTINGENCY MANAGEMENT	Crew members developed effective strategies to manage threats to safety			
EXECUTION Performance Markers				
MONITOR / CROSS-CHECK	Crew members actively monitored and cross-checked systems and other crew members			
WORKLOAD MANAGEMENT	Operational tasks were prioritized and properly managed to handle primary flight duties			
VIGILANCE	Crew members remained alert to the environment and position of the aircraft			
AUTOMATION MANAGEMENT	Automation was properly managed to balance situational and/or workload requirements			
TAXIWAY / RUNWAY MANAGEMENT	Crew members used caution and kept watch outside when navigating taxiways and runways			
REVIEW/MODIFY Performance Markers				
EVALUATION OF PLANS	Existing plans were reviewed and modified when necessary			
INQUIRY	Crew members were not afraid to ask questions to investigate and/or clarify current plans of action			

Overall Performance Markers		Rating
COMMUNICATION ENVIRONMENT	Environment for open communication was established and maintained	
LEADERSHIP	Captain showed leadership and coordinated flight deck activities	
FLIGHT DECK ASSERTIVENESS	Crew members stated critical information and/or solutions with an appropriate persistence level and interpersonal interaction	

CalmAir

LOSA Observation Worksheet

Pre-Departure / Taxi	
Narrative	Your narrative should provide a context. What did the crew do well? What did the crew do poorly? How did the crew perform when confronted with threats, crew errors and significant events? Also, be sure to justify your behavioural ratings

Take-off / Climb	
Narrative	Your narrative should provide a context. What did the crew do well? What did the crew do poorly? How did the crew perform when confronted with threats, crew errors and significant events? Also, be sure to justify your behavioural ratings

Cruise	
Narrative	Your narrative should provide a context. What did the crew do well? What did the crew do poorly? How did the crew perform when confronted with threats, crew errors and significant events? Also, be sure to justify your behavioural ratings

Descent/Approach/Landing/Taxi	
Narrative	Your narrative should provide a context. What did the crew do well? What did the crew do poorly? How did the crew perform when confronted with threats, crew errors and significant events? Also, be sure to justify your behavioural ratings

Briefing to TOD

** Remainder of Descent/Approach/Landing/Taxi Narrative on Next Page **

Overall Flight	
Narrative	This narrative should include your overall impressions of the operation

Did you observe a Flight Attendant briefing on the first leg of the pairing?	☐ YES ☐ NO ☐ UNABLE

LOSA Observation Worksheet

Descent/Approach/Landing/Taxi	
Narrative	Your narrative should provide a context. What did the crew do well? What did the crew do poorly? How did the crew perform when confronted with threats, crew errors and significant events? Also, be sure to justify your behavioural ratings

Issues to consider (if YES, please detail in narrative)

- **Did the approach differ from the one that was briefed? Yes / No**
- **Was the approach changed? Yes / No**
- **Was the runway changed? Yes / No**

TOD to 10,000 ft

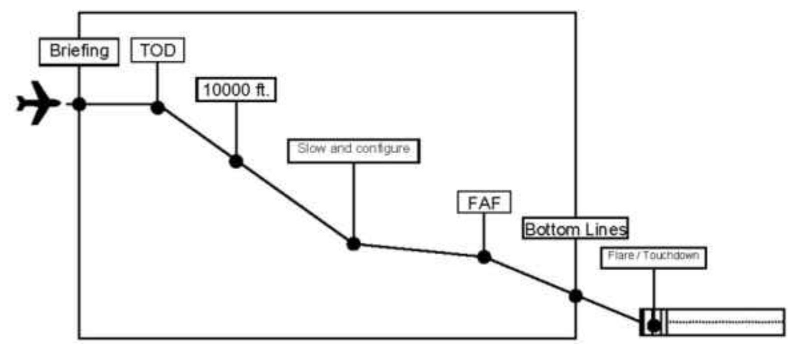
10,000 ft to slowing and configuration

Flare and Touchdown

Taxi

Descent/Approach/Land Technical Worksheet

Descent (above 10,000 feet)				
1. **Was the approach briefed before the TOD?**			☐ YES	☐ NO
2. **Did the crew begin the descent BEFORE or AT the FMS (D328) or 2:1 (ATR) TOD?**			☐ YES	☐ NO
3. **Did the aircraft get significantly (+2000 feet) above or below the standard path?** *(If 'yes', please explain in the narrative the cause, and whether the crew tried to regain the path)*			☐ YES	☐ NO
Approach and Land				
4. **Type of approach flown** *(Check one)*	☐ VISUAL	☐ PRECISION	☐ NON-PRECISION	
5. **Was the visual approach backed up by an instrument system?**		☐ YES	☐ NO	☐ N/A
6. **Was the approach hand-flown or automated?**			☐ HAND-FLOWN	☐ AUTO
7. **Did the aircraft get significantly (+2000 feet) above or below the standard path?** *(If 'yes', please explain in the narrative the cause, and whether the crew tried to regain the path)*			☐ YES	☐ NO
8. **Flap extension:** *(check one which is most appropriate for the average flap extension schedule)*				
☐ Extension comfortably within the envelope				
☐ At minimum manoeuvring speed				
☐ Within 5 kts or at the maximum flap extension speed				
☐ Above the maximum flap extension speed *(If this was the case, please provide narrative)*				
9. **Weather**			☐ VMC	☐ IMC



LOSA Observation Worksheet

THREAT MANAGEMENT WORKSHEET

PHASE OF FLIGHT	THREAT TYPE: ENVIRONMENTAL	THREAT TYPE: AIRLINE	THREAT CODE (sub-category)	THREAT RESPONSE	THREAT OUTCOME
1. Pre-departure / Taxi 2. Takeoff / Climb 3. Cruise 4. Decent / Approach / Land 5. Taxi / Park	1. Adverse Wx 2. Airport 3. ATC 4. Environmental – Operational Pressure	5. A/C Malfunction 6. Airline – Operational Pressure 7. Cabin 8. Dispatch Paperwork 9. Ground Ramp 10. Ground Maintenance 11. Manuals / charts	Please see codes found in appendix.	Was the threat discussed or planned for before it was encountered? 1. Yes 2. No	1. Inconsequential 2. Linked to Flight Crew Error

Threat ID	THREAT DESCRIPTION: Describe the threat	Phase of flight	Altitude	Threat type	Threat code	THREAT MANAGEMENT: Threat response	Threat outcome	Describe how the crew managed or mismanaged the threat with its outcome.
T1								
T2								
T3								
T4								
T5								
T6								
T7								
T8								
T9								
T10								
T11								
T12								

Observer Notes

CalmAir

LOSA Observation Worksheet

ERROR MANAGEMENT WORKSHEET

PHASE OF FLIGHT	ERROR TYPE: A/C HANDLING	ERROR TYPE: PROCEDURAL	ERROR TYPE: COMMS	ERROR CODE (sub-category)	PROFICIENCY-BASED?	WHO CAUSED? WHO DETECTED?	ERROR RESPONSE	ERROR OUTCOME
1. Pre-departure / Taxi 2. Takeoff / Climb 3. Cruise 4. Decent / Approach / Land 5. Taxi / Park	1. Automation 2. Flight Control 3. Ground Navigation 4. Manual Handling 5. Systems / Instruments	6. Briefing 7. Callout 8. Checklist 9. Documentation 10. PF/PNF 11. SOP Cross-verification 12. Other Procedural	13. Pilot-to-Pilot 14. Crew-to-External	Please see codes found in appendix.	Was the threat discussed or planned for before it was encountered? 1. Yes 2. No	1. Nobody 2. Captain 3. First Officer 4. Relief Officer 5. All Crew Members 6. LOSA Observer 7. ATC 8. Flight Attendant 9. Dispatch 10. Ground 11. Maintenance 12. A/C Systems 13. Other	1. Trap 2. Exacerbate 3. Failed to respond	1. Inconsequential 2. Undesired Aircraft State 3. Additional Error

Error ID	ERROR DESCRIPTION: Describe the error	Phase of flight	Altitude	Error type	Error code	Prof-based?	Linking threat ID	ERROR MANAGEMENT: Who caused error?	Who detected error?	Error response	Error outcome	Describe how the crew managed or mismanaged the threat with its outcome.
E1												
E2												
E3												
E4												
E5												
E6												
E7												
E8												
E9												
E10												

Observer Notes

CalmAir

LOSA Observation Worksheet

UNDESIRED AIRCRAFT STATE MANAGEMENT WORKSHEET					
PHASE OF FLIGHT	**UAS TYPE**	**UAS CODE** (sub-category)	**WHO CAUSED? WHO DETECTED?**	**UAS RESPONSE**	**UAS OUTCOME**
1. Pre-departure / Taxi 2. Takeoff / Climb 3. Cruise 4. Decent / Approach / Land 5. Taxi / Park	1. A/C Handling 2. Ground Navigation 3. Incorrect A/C Configuration	Please see codes found in appendix.	1. Nobody 2. Captain 3. First Officer 4. Relief Officer 5. All Crew Members 6. LOSA Observer 7. ATC 8. Flight Attendant 9. Dispatch 10. Ground 11. Maintenance 12. A/C Systems 13. Other	1. Trap 2. Exacerbate 3. Failed to respond	1. Inconsequential 2. Undesired Aircraft State 3. Additional Error

Error ID	UNDESIRED AIRCRAFT STATE DESCRIPTION						UNDESIRED AIRCRAFT STATE MANAGEMENT				
	Describe the error	Linking error ID	Phase of flight	Altitude	UAS type	UAS code	Who caused the UAS?	Who detected the UAS?	UAS response	UAS outcome	Describe how the crew managed or mismanaged the threat with its outcome.
U1											
U2											
U3											
U4											
U5											
U6											
U7											
U8											
U9											
U10											

Observer Notes

Crew Interview Questions

1. Training

Is there a difference in how you were trained, and the reality of line operations?

If so, why?

2. Standardization

How standardized are other crews that you fly with?

If there is a lack of standardization, what do you think is (are) the reason(s)?

3. Automation

What are the most significant automation catches (traps) for this aircraft?

4. Overall safety improvements?

Flight Ops:

Dispatch:

Airport:

Air Traffic Control:

SOPs:

5. General comments and feedback about the LOSA observation:

LOSA CODING

THREAT CODES

ENVIRONMENT THREAT SUB-CATEGORIES

WEATHER (W1-7)

1. Crosswind, tailwind, gusty or high winds aloft
2. Icing only
3. IMC only
4. Thunderstorms/turbulence
5. Turbulence only
6. Windshear
7. z – Other adverse weather threat

AIRPORT (A1-8)

1. Airport construction
2. Contaminated taxiway/runway
3. Lack of or faded signage/markings
4. Complex takeoff/approach requirements (difficult SID/STAR, non-radar environment or noise abatement procedures)
5. Out–of–service/malfunctioning NAVAID/ILS/PAPI
6. Other runway threats
7. Other taxiway/ramp threats
8. z – Other airport threat

ATC (AT1-8)

1. ATC command – challenging clearances, late changes
2. ATC error
3. ATC language difficulty
4. ATC non–standard phraseology
5. ATC radio congestion
6. ATC runway change
7. Similar call signs
8. z – Other ATC threat

ENVIRONMENTAL OPERATIONAL PRESSURE (EO1-6)

1. ACARS communication during high workload
2. Spurious system alert/warning
3. TCAS alert
4. High Terrain
5. Traffic (air or ground congestion)
6. z –Other environmental operational pressure threat

AIRLINE THREAT SUB-CATEGORIES

AIRCRAFT MALFUNCTION (AM1-4)

1. Aircraft malfunction unexpected by crew
2. Automation event or anomaly
3. MEL/CDL with operational implications
4. z – Other aircraft malfunction threat

AIRLINE OPERATIONAL PRESSURE (AO1-3)

1. Crew scheduling event
2. Operational time pressure (delays, OTP, late arriving pilot or aircraft)
3. z – Other airline operational pressure threat

CABIN/COCKPIT (C1-4)

1. Cabin event/distraction/interruption
2. Flight attendant error
3. Significant cockpit distraction/interruption
4. z – Other cabin/cockpit threat

DISPATCH/PAPERWORK (D1-3)

1. Dispatch/paperwork error
2. Dispatch/paperwork event
3. z – Other dispatch/paperwork threat

GROUND/RAMP (GR1-3)

1. Ground crew error
2. Ground handling event
3. z – Other Ground/Ramp threat

GROUND MAINTENANCE (GM1-3)

1. Maintenance error
2. Maintenance event
3. z – Other ground maintenance threat

MANUALS/CHARTS (M1-3)

1. Chart error
2. Manual error
3. z – Other manuals/charts threat

ERROR CODES

AIRCRAFT HANDLING ERROR SUB-CATEGORIES

AUTOMATION (AU1-33)

1. Discretionary omission of FMC/FMGC data
2. Failure to execute a FMC/FMGC mode when needed
3. Failure to execute a MCP/FCU mode when needed
4. Failure to use flight directors
5. Manual aircraft control with MCP/FCU mode engaged
6. Omitted/wrong waypoint or route settings entered into the FMC/FMGC
7. Other MCP/FCU error
8. Other wrong FMC/FMGC entries
9. Wrong altitude entered into the FMC/FMGC
10. Wrong approach selected in FMC/FMGC
11. Wrong FMC/FMGC format for input
12. Wrong FMC/FMGC page displayed
13. Wrong MCP/FCU altitude setting dialed
14. Wrong MCP/FCU course setting dialed
15. Wrong MCP/FCU heading set or dialed
16. Wrong MCP/FCU mode executed
17. Wrong MCP/FCU mode left engaged
18. Wrong MCP/FCU navigation select setting (NAV,GPS,ILS,VOR switch)
19. Wrong MCP/FCU setting on autothrottle switch
20. Wrong MCP/FCU speed setting dialed
21. Wrong MCP/FCU vertical speed/flight path angle setting
22. Wrong mode executed in the FMC/FMGC
23. Wrong mode left engaged in the FMC/FMGC
24. Wrong present position entered into the FMC/FMGC
25. Wrong setting on the MCP/FCU autopilot or flight director switch
26. Wrong speed setting entered into the FMC/FMGC
27. Wrong weight and balance calculations entered into FMC/FMGC
28. Intentional Noncompliance – Nonstandard or wrong MCP/FCU settings
29. Intentional Noncompliance – Nonstandard automation usage
30. Intentional Noncompliance – Other automation error
31. Inappropriate disconnection of automatics
32. z – Other automation error

FLIGHT CONTROL (FC1-16)

1. Attempting to use INOP controls
2. Decision to use wrong thrust/power
3. Failure to engage thrust reversers on landing
4. Failure to raise or lower landing gear on schedule
5. Wrong autothrottle setting
6. Wrong autobrake setting
7. Wrong flaps setting
8. Wrong thrust/power settings
9. Wrong speed brakes setting
10. Wrong spoilers setting
11. Wrong stab trim settings
12. Wrong thrust reversers setting
13. Intentional Noncompliance – Failure to arm spoilers
14. Intentional Noncompliance – Use of excessive power on pushback
15. Intentional Noncompliance – Other flight control error
16. z – Other flight control error

GROUND NAVIGATION (GN1-13)

1. Attempting or turning down wrong gate/taxiway/ramp/hold spot
2. Attempting or turning down wrong runway
3. Attempting to taxi off C/L
4. Failure to hold short
5. Missed gate
6. Missed runway
7. Missed taxiway

8. Taxi on taxiway/runway with oncoming traffic
9. Taxi too close to other aircraft
10. Taxi too fast
11. Intentional Noncompliance – Taxi above speed limit
12. z – Intentional Noncompliance – Other ground navigation error
13. z – Other ground navigation error

MANUAL HANDLING (MH1-23)

1. Attempting or lining up for incorrect runway for landing
2. Unnecessary low maneuver on approach
3. Excessive brake use
4. Landing deviation by choice
5. Lateral or vertical deviation by choice
6. Decision to navigate through known bad weather that increased risk
7. Speed deviation by choice
8. Unintentional bank deviation
9. Unintentional crosswind technique
10. Unintentional landing deviation
11. Unintentional lateral deviation
12. Unintentional pitch deviation
13. Unintentional speed deviation
14. Unintentional vertical deviation
15. Unintentional vertical speed deviation
16. Unintentional weather penetration
17. Unintentional yaw deviation
18. Intentional Noncompliance – Intentionally flying below the G/S
19. Intentional Noncompliance – Intentionally flying a nonstandard visual approach
20. Intentional Noncompliance – Intentionally not following published Jepp procedures
21. Intentional Noncompliance – Unauthorized speed deviation
22. z – Intentional Noncompliance – Other manual flying error
23. z – Other manual flying error

SYSTEMS/INSTRUMENT/RADIO (SI1-26)

1. Failure to respond to GPWS warnings
2. Failure to respond to TCAS warnings
3. Failure to turn on A/C packs (no pressurization)
4. Incorrect nav display setting
5. Wrong ACARS entries
6. Wrong altimeter settings
7. Wrong anti–ice setting
8. Wrong ATC frequency dialed/selected
9. Wrong ATIS frequency dialed
10. Wrong bug settings
11. Wrong display switch setting
12. Wrong fuel switch setting
13. Wrong nav radio frequency dialed
14. Wrong panel setup for engine start
15. Wrong radar settings
16. Wrong squawk
17. Wrong TCAS setting
18. Intentional Noncompliance – Failure to respond to GPWS warnings
19. Intentional Noncompliance – Failure to respond to TCAS warnings
20. Intentional Noncompliance – Setting altimeters before the transition altitude or trans level
21. Intentional Noncompliance – Using equipment placarded as INOP
22. Intentional Noncompliance – Failure to respond to overspeed warning
23. Intentional Noncompliance – Unauthorized response to aircraft warning
24. Intentional Noncompliance – Wrong bug settings
25. z – Intentional Noncompliance – Other systems/inst/radio error
26. z – Other systems/inst/radio error

PROCEDURAL ERROR SUB-CATEGORIES

BRIEFING (B1-19)

1. Brief performed late
2. Incorrect/incomplete approach brief
3. Incorrect/incomplete depart review/takeoff brief
4. Incorrect/Incomplete F/A brief
5. Omitted approach briefing
6. Omitted departure review/takeoff briefing
7. Omitted required engine–out briefing
8. Omitted required F/A briefing
9. Intentional Noncompliance – Incorrect/incomplete approach briefing
10. Intentional Noncompliance – Omitted depart review/T/O briefing
11. Intentional Noncompliance – Omitted handover briefing
12. Intentional Noncompliance – Omitted required engine–out briefing
13. Intentional Noncompliance – Incorrect/incomplete depart review/T/O briefing
14. Intentional Noncompliance – Incorrect/Incomplete F/A brief
15. Intentional Noncompliance – Intentional late brief
16. Intentional Noncompliance – Omitted approach briefing
17. Intentional Noncompliance – Omitted required flight attendant briefing
18. z – Intentional Noncompliance - Other briefing error
19. z – Other briefing error

CALLOUT(CO1-18)

1. Incorrect approach callouts
2. Incorrect climb or descent callouts
3. Incorrect V–speed callouts
4. Omitted approach callouts
5. Omitted climb or descent callouts
6. Omitted landing callouts
7. Omitted altitude callouts
8. Omitted V–speed callouts
9. Intentional Noncompliance – Omitted altitude callouts
10. Intentional Noncompliance – Nonstandard altitude callouts
11. Intentional Noncompliance – Nonstandard approach callouts
12. Intentional Noncompliance – Omitted approach callouts
13. Intentional Noncompliance – Omitted climb or descent callouts
14. Intentional Noncompliance – Nonstandard climb or descent callouts
15. Intentional Noncompliance – Nonstandard V–speed callouts
16. Intentional Noncompliance – Omitted V–speed callouts
17. z – Intentional Noncompliance – Other callout error
18. z – Other callout error

CHECKLIST (CK1-21)

1. Checklist not performed to completion
2. Checklist performed late or at the wrong time
3. Completed checklist not called 'complete'
4. Missed checklist item
5. Omitted abnormal checklist
6. Omitted checklist
7. Wrong checklist performed
8. Wrong response to a challenge on a checklist
9. Intentional Noncompliance – Checklist performed from memory
10. Intentional Noncompliance – Completed checklist not called 'complete'
11. Intentional Noncompliance – Omitted abnormal checklist
12. Intentional Noncompliance – Self–initiated checklist (not called for by CA)
13. Intentional Noncompliance – Use of nonstandard checklist protocol
14. Intentional Noncompliance – Checklist not performed to completion
15. Intentional Noncompliance – Checklist performed as "to–do" checklist
16. Intentional Noncompliance – Checklist performed late or at wrong time
17. Intentional Noncompliance – Omitted checklist
18. Intentional Noncompliance – Self–initiated checklist (not called for by PF)
19. Intentional Noncompliance – Self–performed checklist – no challenge and response
20. z – Intentional Noncompliance – Other checklist error
21. z – Other checklist error

DOCUMENTAYION (XX1-18)

1. Incorrect or failing to make an entry into the logbook
2. Miscalculation of hold times
3. Misinterpreted items on flight documentation
4. Missed items on flight documentation (flight plan, NOTAM, dispatch release)
5. Wrong clearance recorded

LOSA CODING

6. Wrong fuel information recorded
7. Wrong or no ATIS information recorded
8. Wrong or no Jepp pages out (approach plates, 10–7 page, etc.)
9. Wrong performance chart used
10. Wrong runway information recorded
11. Wrong times calculated in flight plan
12. Wrong V–speeds recorded
13. Wrong weight and balance information recorded
14. Intentional Noncompliance – Failure to make logbook entry
15. Intentional Noncompliance – No Jepp pages out (approach charts, 10–7 page, etc.)
16. Intentional Noncompliance – T/O without proper weight & balance figures
17. z – Intentional Noncompliance – Other documentation error
18. z – Other documentation error

PF/PNF (PL1-9))

1. PF makes own FMC/FMGC changes
2. PF makes own MCP/FCU changes
3. PNF performs PF automation duties
4. Intentional Noncompliance – PF makes own FMC/FMGC changes
5. Intentional Noncompliance – PF sets own flight controls or switches
6. Intentional Noncompliance – PF makes own MCP/FCU changes
7. Intentional Noncompliance – PNF carried out PF duties
8. z – Intentional Noncompliance – Other PF/PNF duty error
9. z – Other PF/PNF duty error

SOP CROSS VERIFICATION (SOP1-19)

1. Failure to clarify MEL or logbook entry
2. Failure to cross–verify altimeter settings
3. Failure to cross–verify automation navigation with raw data
4. Failure to cross–verify clearance
5. Failure to cross–verify documentation or paperwork
6. Failure to cross–verify FMC/FMGC inputs
7. Failure to cross–verify MCP/FCU/altitude alerter changes
8. Failure to cross–verify speed before flap selection
9. Failure to monitor engine start
10. Omitted flight mode annunciation
11. Intentional Noncompliance – Failure to cross–verify paperwork
12. Intentional Noncompliance – Failure to cross–verify altimeter settings
13. Intentional Noncompliance – Failure to cross–verify FMC/FMGC/CDU changes
14. Intentional Noncompliance – Failure to cross–verify manual with paperwork
15. Intentional Noncompliance – Failure to cross–verify MCP/FCU/altitude alerter changes
16. Intentional Noncompliance – Nonstandard cross–verification
17. Intentional Noncompliance – Omitted flight mode annunciation
18. z – Intentional Noncompliance – Other SOP cross verification error
19. z – Other SOP cross verification error

OTHER PROCEDURAL (OP1-21)

1. Duties performed at inappropriate time
2. Decision not to ask FA to stay seated for bad weather
3. Decision not to turn on seat belt sign in bad WX
4. Failure to G/A after stabilised approach window
5. Omitted RVSM procedure
6. Pushback without clearing right or left
7. Taxi to line up with unready cabin
8. Unintentional operation with MEL
9. Wrong MEL action performed
10. Crew omitted cabin/flight attendant call
11. Intentional Noncompliance – Failure to use proper WX SOP
12. Intentional Noncompliance – Operation with unresolved aircraft malfunction
13. Intentional Noncompliance – Operation with unresolved MEL
14. Intentional Noncompliance – Admin duties performed at inappropriate times
15. Intentional Noncompliance – Failure to G/A after stabilized approach window
16. Intentional Noncompliance – Nonstandard "ready to push" procedures
17. Intentional Noncompliance – Taxi duties performed before leaving runway
18. Intentional Noncompliance – Taxi–in duties performed before crossing an active runway
19. Intentional Noncompliance – Inappropriate taxi–in or out without wing walkers
20. z – Intentional Noncompliance – Other procedural error
21. z – Other procedural error

COMMUNICATION ERROR SUB-CATEGORIES

PILOT TO PILOT (PP1-11)

1. Crew miscommunication of information
2. Failure to communicate approach information
3. Misinterpretation of ATIS
4. Missed command within crew
5. Wrong airport communicated
6. Wrong nav aid communicated
7. Wrong runway communicated
8. Wrong taxiway/ramp/gate/hold spot communicated
9. Intentional Noncompliance – Sterile cockpit violation
10. z – Intentional Noncompliance– Other pilot to pilot communication error
11. z – Other pilot to pilot communication error

CREW TO EXTERNAL (CE1-22)

1. Crew did not repeat ATC clearance
2. Crew omitted ATC call
3. Failure to give readbacks or callbacks to ATC
4. Incomplete clearance readback
5. Misinterpretation of ATC instructions
6. Misinterpretation of ground instructions
7. Misinterpretation of tower instructions
8. Missed ATC calls
9. Omitted call signs to ATC
10. Omitted non–radar environment report to ATC
11. Omitted position report to ATC
12. Use of nonstandard ATC phraseology
13. Wrong position report
14. Wrong readbacks or callbacks to ATC
15. Intentional Noncompliance – Accepting a landing clearance 10+ knot tailwind
16. Intentional Noncompliance – Omitted ATC calls
17. Intentional Noncompliance – Omitted call signs to ATC
18. Intentional Noncompliance – Omitted non–radar environment report to ATC
19. Intentional Noncompliance – Use of nonstandard ATC phraseology
20. Intentional Noncompliance – Omitted position report to ATC
21. z – Intentional Noncompliance – Other crew to external communication error
22. z – Other crew to external communication error

Calm Air International LP
FLIGHT OPERATIONS

MEMO FLT CRW 2014-12

To: All Pilots
From: Ryan Mitchell, LOSA Project Manager
Date: 20 May 2014
Subject: Line Operations Safety Audit (LOSA) – August/September 2014

Commencing in August and running for approximately six weeks, Calm Air will conduct a Line Operations Safety Audit (LOSA). LOSA consists of **non-jeopardy, de-identified cockpit observations** of airline crews conducting normal flight operations. Analysis of these observations provides a 'snapshot' of how things are running in our operation – think of it as a kind of safety 'health check'.

The ultimate customer of this audit should be the Calm Air line pilot. By that, I mean that the audit should help us identify problem areas so that we can correct them and make the job easier and safer. LOSA should help us identify the strengths and weaknesses of our crew procedures and with that information, management is committed to making the necessary changes to continually improve the way that we conduct our operations.

As mentioned above, LOSA observations are non-jeopardy events and all data are confidential and de-identified. Be assured that these observations are not checkrides or line checks. While some LOSA observers may be Calm Air Check Pilots, they are not there to critique your performance – their mission is to be an unobtrusive observer and to fill out data collection forms after the flight is completed.

Last month, we formed a LOSA Steering Committee made up of Flight Operations Management and line pilot representation nominated by the Air Line Pilots Association whose goal it is to ensure this process is conducted with integrity, trust and effectiveness. Simply put, we're conducting a LOSA so that we can improve our operation and better support our flight crews, and once complete, we're committed to telling you how it went and how we plan to make improvements.

Along with this letter is a brief introduction to LOSA with some frequently asked questions. If you are interested in volunteering as a LOSA observer, please see the attached information sheet; **expressions of interest should be directed to Capt. Mike Rawlings by email by end of day on Sunday, June 8th.**

FLT CRW 2014-12 Page 1 of 2

While the LOSA concept is familiar to large airlines, we are aware of only three other air operators in Canada (Air Canada, WestJet & Air Georgian) that have used it. This is an exciting and challenging process that demonstrates the commitment, trust and safety leadership that is required to make gains in the safety of flight operations and as a steering committee, we aim for this process to reflect positively on the professionalism of Calm Air flight crews and our operation as a whole.

If you have any questions or concerns about LOSA, please contact any member of the LOSA Steering Committee for more information.

Best Regards,

FO Ryan Mitchell
LOSA Project Manager
rmitchell@calmair.com

Capt. Mike Rawlings
Air Line Pilots Association
mrawlings@calmair.com

Capt. Rob Astwood
Director, Flight Operations
rastwood@calmair.com

FO Steve Bryce
Air Line Pilots Association
sbryce@calmair.com

Capt. Bill Stock
Chief Pilot
bstock@calmair.com

AN INTRODUCTION TO LOSA

What LOSA IS

- An assessment of strengths and weaknesses in Flight Operations
- Defined by 10 operating characteristics:
    1. Jumpseat observations during normal operations
    2. Anonymous and confidential data collection
    3. Voluntary crew participation
    4. Joint management/pilot association sponsorship
    5. Trusted and trained observers
    6. Safety-targeted data collection
    7. Trusted data collection site
    8. Data cleaning roundtables
    9. Data-derived targets for enhancement
    10. Results feedback to line pilots

What LOSA IS NOT

- A Regulatory Compliance Audit
- A New Form of Line Check
- Next Generation CRM Training

Q: Who will run the LOSA program?

The LOSA will be run 'in-house', managed by a steering committee made up of line pilots and Flight Operations management.

Q: Who will act as the observers?

LOSA observers will be Calm Air flight crew volunteers interested in safety promotion within the airline.

Q: Is LOSA a check on me personally?

No. LOSA is an audit of systems and procedures, not individuals. While the observer group my end up consisting of some Training and Check Pilots, no data will be used to identify an individual.

Q: What happens if my name ends up on a 'bad' report?

No names are ever entered onto a LOSA observer's report form. All flight information is de-identified and once entered into a database, the forms are destroyed.

Q: What if I don't want a LOSA observer on my flight?

If a crew member does not want to participate in the LOSA program, they will not be compelled to do so, with no negative implications associated with their decision. Participation is on a voluntary basis, however crews are reminded that the program is non-jeopardy for individuals taking part.

Q: What will Calm Air do with the collected LOSA data?

Airlines around the world have found LOSA useful in identifying problems with systems and procedures and have applied solutions to fix these problems before they resulted in accidents or incidents. LOSA will provide us a 'snapshot' of our operation that will identify risk areas for mitigation and also highlight examples of superior performance that can be reinforced and used as models for training.

CAV LOSA | 2014
LINE OPERATIONS SAFETY AUDIT

CalmAir

LOSA OBSERVERS: REQUEST FOR VOLUNTEERS

Volunteers are requested from Captain and First Officer ranks (any aircraft type) to undertake the duties of LOSA observers (auditors) during the period of the audit.

Observers should be motivated by the opportunity to contribute to safety promotion, must have strong computer skills and must be able to maintain strict confidentiality and professionalism during the audit.

A four-day training course will be provided (28-31 July, 2014) and will be placed on the July bid package/schedule.

Following training, LOSA activities will begin the first week of August and flight observation duties will be completed by mid-September. LOSA observation duties will be scheduled and are not in addition to the pilot's existing workload.

Volunteers are asked submit their expressions of interest to Capt. Mike Rawlings by email (mrawlings@calmair.com) by end of day on Sunday, June 8th.

Q: What kinds of tasks will I have to do as an observer?

You will sit as a silent jumpseat observer on scheduled line flight and make notes in a small notebook about how the crew managed the events during the flight. After the flight, you will use your notes to complete worksheet observation forms that will then be entered into a database.

Q: How many observers are you looking for? How many observations would I have to do?

We're looking for 6-8 line pilots to volunteer as observers. Each observer would be expected to complete about 10 observations. Observers do not need to be type qualified on the aircraft; we expect to have ATR and Hawker pilots observing Dornier flights, and vice versa.

Q: How will I be scheduled for observation flights?

As of right now, we anticipate creating 1-day and 2-day 'pairings' for observers that will be pre-bid in the August and September bid packages. Essentially, you would bid on a combination of flight legs to satisfy the requirement to capture specific flights. (Example: MO503 YWG-YGX-YTH, then MO502 YTH-YWG). Observers would expect 5-6 days worth of these pairings spread across August and early September, with the rest of the schedule being made up of regular flying (as bid by seniority in the normal bidding process.

Q: How will I be paid when I am conducting observations?

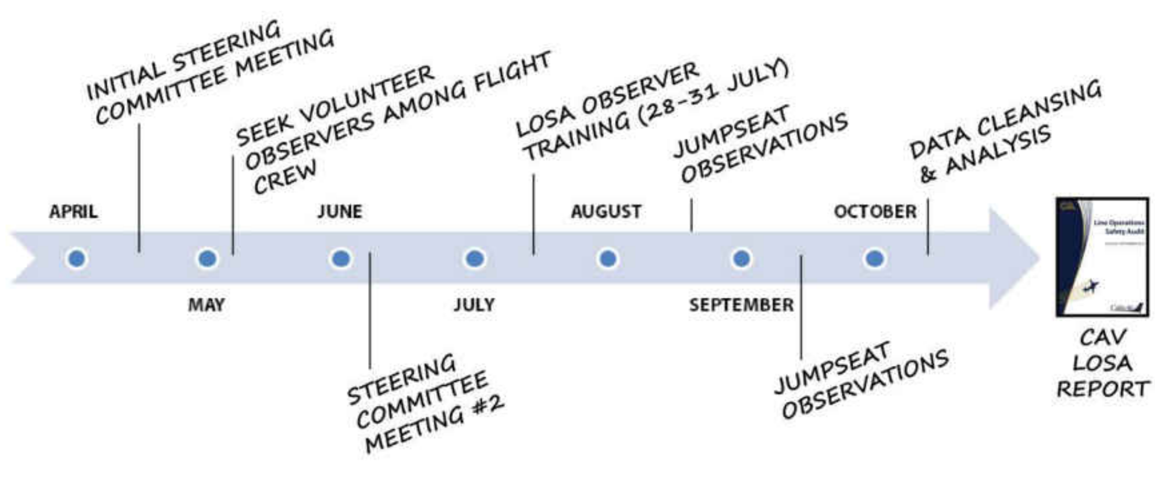
We anticipate that the credit value for 'observer pairings' will be calculated as outlined in the collective agreement as if you were a crewmember on that pairing. Per diems and meal allowance remain in effect. The intention here is to support the unique scheduling requirements of this audit without creating a financial disadvantage to volunteering for observer duties.

CAV LOSA | 2014

LINE OPERATIONS SAFETY AUDIT

CalmAir

LOSA TIMELINE



LOSA STEERING COMMITTEE

FO Ryan Mitchell
LOSA Project Manager
rmitchell@calmair.com

Capt. Mike Rawlings
Air Line Pilots Association
mrawlings@calmair.com

FO Steve Bryce
Air Line Pilots Association
sbryce@calmair.com

Capt. Rob Astwood
Director, Flight Operations
rastwood@calmair.com

Capt. Bill Stock
Chief Pilot
bstock@calmair.com