LOSA Advisory Circular

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INTRODUCTION

What is the purpose of this Advisory Circular?

This circular provides the rationale and procedure for conducting a Line Operations Safety Audit (LOSA) at an airline.

To whom does this Advisory Circular apply?

This circular is relevant for airline personnel in flight safety, flight training, and flight operations. It is also relevant for personnel in ground operations and in-flight services.

Contents of the Advisory Circular

The first section—what is a LOSA—introduces the LOSA process and distinguishes it from other proactive safety data programs such as FOQA and ASAP. The next section—why do a LOSA—lists the various types of data collected via a LOSA and shows how they contribute to an airline’s safety management system. Next, the personnel involved in a LOSA and their respective roles are described. The longest section—how to implement a LOSA—is a detailed step-by-step guide to the LOSA process from initial planning to the final report. The Circular concludes with The Ten Operating Characteristics that define a LOSA and ensure the integrity of the process. Under the guidance of this Circular, an airline wanting to implement a LOSA must abide by all ten characteristics.

Appendix A describes the Threat and Error Management (TEM) model upon which the LOSA method was based. Appendix B provides a brief history of the development of the LOSA methodology. A sample observation form and a sample letter to the pilots are provided in Appendixes C and D.

WHAT IS LOSA

A Line Operations Safety Audit (LOSA) is a formal process that requires expert and highly trained observers to ride the jumpseat during regularly scheduled flights in order to collect safety-related data on environmental conditions, operational complexity, and flight crew performance. Confidential data collection and non-jeopardy assurance for pilots are fundamental to the process.

Using a medical metaphor, a LOSA is similar to a patient’s annual physical examination. People have comprehensive check-ups in the hope of detecting serious health issues before they become consequential. A set of diagnostic measures, such as blood pressure, cholesterol, and liver function, flag potential health concerns which in turn suggest needed changes to the patient’s current lifestyle. A LOSA is built upon the same proactive notion. It provides a diagnostic snapshot of strengths and weaknesses that an airline can use to bolster the “health” of its safety margins and prevent degradation.

LOSA is distinct from but complementary to other proactive safety programs such as electronic data acquisition systems (i.e., FOQA), and voluntary reporting systems (i.e., ASAP). There are two major conceptual differences. First, FOQA and ASAP rely on outcomes to generate data. For FOQA, it is flight parameter exceedances, and for ASAP, it is adverse events that crews report. By contrast, LOSA samples all activities in normal
operations. In these regularly scheduled flights, there may be some reportable events, but there will also be some near-events, and importantly, a majority of well-managed, successful flights. LOSA provides a unique opportunity to study the flight management process, both successful and unsuccessful, by noting the problems crews encounter on the line and how they manage them.

The second major difference is the perspective taken by each program. With its focus on electronic data acquisition downloaded directly from the aircraft, FOQA can be said to have the “airplane perspective”. ASAP provides the “pilot perspective” by utilizing pilots’ voluntary disclosure and self-reporting of events. ASAP reports provide insight into why events occur, as seen from the crew’s perspective. By contrast, LOSA provides a “neutral, third party perspective” in that LOSA observers record contextual and flight crew data on every phase of flight, regardless of the outcome. All three perspectives provide useful data to an airline’s safety management system.

A third, more pragmatic, difference between the programs relates to logistics. FOQA and ASAP are continuous programs, i.e., they are set up to collect data on a daily basis. A LOSA is more project-based. The full LOSA process, from advance planning and observer selection and training, to data collection, analyses and final report, can take between six and twelve months. A LOSA is recommended every three years. Despite these differences, data from one program can be cross-referenced and used to guide data collection in another. For example, ASAP reports may highlight a problem with departures at a particular airport. This information can be fed to the LOSA steering committee who can then target more observations out of that airport in order to understand the magnitude and specifics of the problem. As another example, a LOSA may identify a high incidence of unstable approaches, leading to a review of procedures and the specification of new approach parameters. FOQA data can track adherence to the new specifications in the interim period leading up to the next LOSA.

**WHY DO A LOSA**

A LOSA provides unique data about an airline’s defenses and vulnerabilities. As explained above, a LOSA does not replace other safety-data sources such as FOQA or ASAP. Instead, it complements these programs and extends the reach of an airline’s safety management system. The data collected during a LOSA can impact almost every department in an airline, as the following examples show. The data collected during a LOSA can help an airline:

- **Identify threats in the airline’s operating environment**

  Observers note events in the operational environment, e.g., adverse weather, airport conditions, ATC clearances, terrain, and traffic congestion, and how they are managed by flight crew. High-prevalence threats and/or threats with higher mismanagement rates can be prioritized for further investigation; lower mismanagement rates signify areas of strength.

  For example, understanding the extent to which certain airports or ATC pose a problem for flight crews, and capturing the strategies flight crews adopt to deal
with them, can lead an airline to develop special procedures or advisories to help its pilots manage the known threat.

- **Identify threats from within the airline’s operations**
  Observers note events arising from within the airline’s own operations and how they are managed, e.g., operational time pressure, dispatch errors, aircraft malfunction/MEL items, and problems with ground, ramp, maintenance, and cabin personnel. A high number of threats arising from dispatch or cabin might signal that these departments require attention, or that inter-group co-operation with pilots needs to be improved, or that procedures are inconsistent across departments. As above, prevalence and management rates provide cues for prioritizing action.

- **Assess the degree of transference of training to the line**
  Data provided by AQP, LOEs, and LOFTs can provide insight on whether training concepts are learned, but not whether they are actually practiced on line. A LOSA provides that operational information, which can be reviewed from a training perspective to understand which areas of training, if any, are not transferring successfully to the line.

- **Check the quality and usability of procedures**
  A LOSA provides insights about potential problems with procedures. For example, if 5% of observed crews make a callout error during descent/approach/land, there may be a problem with those crews. However, if 50% of observed crews make the same error, then the evidence suggests a problem with the callout procedure. Procedures can be ill-timed, over-long, confusing, and/or compete for the pilots’ attention with other more important activities. A LOSA will locate problematic procedures and policies via poor adherence rates. A LOSA can also identify the extent of procedural deviations across fleets.

- **Identify design problems in the human-machine interface**
  A LOSA captures aircraft handling and automation errors on different fleets that can highlight systemic flaws in design, interface, or adaptation. The rate at which certain errors go undetected and become consequential can also indicate potential design vulnerabilities. An airline can feed these LOSA findings back to the aircraft manufacturers, as well as writing SOPs to circumvent the flaws.

- **Understand pilots’ shortcuts and workarounds**
  With experience comes expertise; pilots learn ways to save time and be more efficient. These techniques are rarely seen in a line check, when performance is usually done “by the book”. A LOSA provides a principled manner by which an airline can capture collective expertise from within the pilot group, and then share that information with all its pilots through formal airline communication channels. Using LOSA, false expertise—the adoption of a shortcut or workaround that is flawed in its safety assumptions—can also be identified and remedied.
Assess safety margins

Threats and errors that are mismanaged can result in undesired aircraft states if sufficiently serious. Vertical and lateral deviations and unstable approaches are examples of undesired aircraft states, also known as accident and incident precursors. A LOSA provides data about the prevalence and management of these incident and accident precursors. Thus, an airline acquires data about how close it is operating to the edge of the safety envelope, without crossing the boundary into an incident or accident.

Provide a baseline for organizational change

LOSA results provide baseline and outcome measurement data against which organizational interventions can be measured. Using the medical metaphor, this would be akin to the patient deciding to cut out fried foods upon learning of a high cholesterol count. The next check-up reveals, in quantifiable form, whether this strategy has been effective in reducing cholesterol or whether other actions are necessary. Similarly, a follow-up LOSA provides a new set of results which will show whether the organizational changes were effective in reducing certain threats, errors, and/or undesired states.

Provide a rationale for allocation of resources

Because LOSA results highlight both the strengths and weaknesses in an organization, the results provide a data-driven rationale for prioritizing and allocating scarce organizational resources toward interventions.

WHO IS INVOLVED IN A LOSA

When first exploring whether or not to conduct a LOSA, it is advisable to gather representatives from all departments that may be potentially involved, including flight operations, training, flight standards, the safety department, and the pilot group.

Departments

The flight operations and training departments typically know first-hand what is and is not working well. These departments often have specific areas that they would like the LOSA to focus on. Possibly the most important reason for their involvement is that ultimately many of the problem areas that are identified during a LOSA must be addressed by these departments. They will also be the recipients of the potential benefits derived from the LOSA. If these departments do not support LOSA, then there will be resistance to the findings; however, if these departments are part of the process, there will be a sense of ownership, and they will be invested in the results.

Pilots’ Association or Group

The importance of having the pilots involved with and supporting the LOSA cannot be overstated. If the line pilots are convinced that their association or pilot group supports LOSA, they will be more willing to accept the presence of
observers on their flight decks. Additionally, if pilots believe this process is beneficial to them and to safety, they will be forthcoming and candid with their views and safety concerns. On the other hand, if the pilots view LOSA as a management tool to “spy on their cockpits” and they respond with “angel” performance rather than typical performance, then the results will not be fruitful.

Hence, where airlines have a formal pilots’ association, leaders of the association must be involved in the LOSA process from the beginning. If no formal pilots’ association exists, pilot representatives must be included. The pilots’ association or group can also help disseminate the results of the LOSA and inform the pilots as to the company’s plans as a result of the LOSA.

**LOSA Coordinator & Steering Committee**

Because buy-in and support is crucial, consideration should be given to forming a LOSA steering committee drawn from the various departments and the pilots’ association.

The LOSA steering committee and/or the LOSA coordinator have many tasks and logistical responsibilities, including:

- Publicize the upcoming LOSA in pilot newsletters to build awareness;
- Distribute a letter to all line pilots explaining the purpose of the LOSA; (Appendix D has a sample letter.)
- Decide the size and focus of the LOSA
- Select the observers, organize their schedules, and set up observer training;
- Organize a secure site for collection of the observation forms and subsequent data analysis.

All of these tasks are discussed in more detail in the “How to” section of this document.

**Observers**

LOSA observers must be carefully selected to ensure the integrity of the LOSA process. LOSA observers must be familiar with the airline’s procedures and operations; they must also be respected by the line pilots. The observer team can include some non-pilots as long as they can anticipate and understand flight crew tasks and their surrounding operational context; however, the majority of the team should be active or recently retired pilots from the airline.

A LOSA observer must be like a “fly on the wall”, able to occupy the cockpit jump-seat and capture data without being obtrusive or interfering with the crew’s performance. This involves creating an environment where the crew almost does not realize they are being observed. LOSA observers must also understand that they are data collectors only, and not evaluators there to critique crews.
Line Pilots

A LOSA cannot succeed without the full and candid co-operation of the line pilots, and there can be no co-operation without trust. Line pilots must be informed in advance about the purpose and planned implementation of a LOSA. They should receive a letter co-signed by credible representatives of both management and the pilot organization that assures them of the confidential and non-jeopardy status of LOSA data. The letter should also include a disclaimer giving all pilots the choice of declining a jumpseat observer at their discretion. Only by building in these guarantees and safeguards will the line pilots feel sufficiently comfortable to act normally in the cockpit in the presence of a LOSA observer. A final assurance should be an in-house publication of a summary of LOSA results along with an outline of initial actions and proposed changes.

Data Analyst and Report Writer

The data analyst should have knowledge of the airline’s flight operations as well as database management and data analysis skills. However, an airline might choose a third party analyst if expertise is not available in-house, or if line pilots have expressed reservations about the integrity of the LOSA implementation or objectivity of the final report.

The data analyst and report writer work together to prepare a report of the findings to be presented to management and pilots.

WHEN TO CONDUCT A LOSA

There are several factors to consider when scheduling a LOSA. Given all the personnel involved, a LOSA should be scheduled to fit with other operational priorities. For example, is there a particular time in the year when more observers will be available? Is there a better time for the Scheduling department to roster these people? Also, is there a particular time that is more interesting from a safety or operational perspective? Some examples: bad-weather season, peak traffic season, after the introduction of an operational change such as new aircraft, altered routes, or a merger.

A LOSA must not be implemented immediately after a major incident or accident. The airline will be in a heightened state of awareness at this time, and pilots will be overly sensitive to observation; hence, the chances of getting normal data will be diminished. At a minimum, airlines should wait at least one year after a major safety event before scheduling a LOSA.

Once an airline has done a LOSA, a critical question is when to do the next one. LOSA data provide a baseline against which to measure improvements. A realistic time frame to review LOSA results, develop and implement action plans, and monitor results is three years. Hence, to measure the effectiveness of organizational changes, a repeat LOSA every three years is recommended.
HOW TO IMPLEMENT A LOSA

This section presents a step by step guide to implementing a LOSA. Broadly speaking, there are steps associated with getting good-quality data from observers (Data Collection), and steps associated with ensuring that accurate and meaningful data are given to management and line pilots (Data Analysis & Feedback). An airline can conduct its own LOSA by observing the following steps.

DATA COLLECTION

1. Form a LOSA steering committee and appoint a LOSA coordinator

2. Gather information and LOSA resources from other airlines and industry groups

Before conducting a LOSA for the first time, the committee and coordinator should seek out information from other airlines that have already conducted a LOSA. Other airlines may be able to share observer selection and training techniques, observation forms, scheduling tips, and other logistical aids.

3. Publicize LOSA within the airline and send a letter to the line pilots

A first task is advance publicity via company publications to build line pilot awareness and acceptance of the upcoming LOSA. Next, the coordinator organizes and distributes a letter to all pilots explaining the purpose of the LOSA. This letter specifies the purpose of the audit, the fact that all observations are of a non-jeopardy nature, and that all data will be kept strictly confidential. The letter is signed by the highest level of management within flight operations, with the endorsement of other relevant personnel such as chief pilots and pilots’ representatives. (Appendix D has an example letter.)

The letter of announcement should precede the line audit by at least one month, with a follow-up alert one week before starting observations. LOSA observers should have copies of the signed letter to show crewmembers in case questions arise.

4. Decide the focus of the LOSA

The LOSA steering committee decides the focus of LOSA. One option is to sample broadly across the entire operation—this would be an effective strategy for a first LOSA. Alternately, the LOSA steering committee can focus on problems that have been identified by other data sources, such as FOQA and ASAP. This approach would schedule LOSA observations on particular routes, in certain regions, or into particular airports that have been identified as problematic. The committee can also focus a LOSA on a new fleet or other recent organizational changes.

5. Decide the number of observations

Most airlines will find it cost effective to conduct a LOSA on a sample of their operation—the question is how big a sample?
As a general guideline for a full LOSA, match the number of observations per fleet to the relative number of departures per day. For example, if 30% of departures occur on Fleet A, then approximately 30% of the LOSA observations should occur on Fleet A. Within each fleet, try to sample as many different crews as possible, and as a rule, conduct 50 or more observations per fleet. Below that number, there is the risk of not accurately capturing a representative sample.

Modify the guideline slightly when focusing on a particular operation or region. For example, to sample international flights into a particular sub-continent, then regardless of what percentage they constitute of the airline’s daily departures, still schedule at least 50 observations to ensure a good sample.

6. Create an observation form

The observation form should be based on a conceptual framework that captures multiple aspects of normal operations, including the operating environment and flight crew performance. It should provide categories and codes to streamline observations and save the observer’s time, but it should also require a written description of the flight that captures the full context. Appendix C has an example observation form based upon the Threat and Error Management (TEM) model.

7. Select observers

The observer team should have representatives from flight operations, training, safety, and the pilots’ association. Some airlines employ a selection procedure whereby management and the pilots’ association each put forth a list of acceptable observers, and then those who appear on both lists are selected.

The number of observers needed depends on the size of the audit and the observers’ workload. There is substantial work involved in completing an observation form and providing a detail-rich narrative for each flight; therefore, the recommended number of observations is 10-15 per observer, depending on routes and schedules. Hence, a LOSA that plans 150 domestic observations requires at least 10 observers, while a 300-observation LOSA that includes international flights requires 20-25 observers.

8. Train observers

LOSA observers must be educated about the purpose and rationale of LOSA, and trained in the use of the observation tool. LOSA observer training typically takes two to three days. To assist in the design of the training, members of the steering committee may want to attend LOSA observer training at another airline first, or attend an industry-sponsored LOSA Conference1 for guidance.

Observers should practice with scripted scenarios or videos until they are confident they can use the observation form correctly. At this point, they can be dispatched to the line; however, it is recommended that observers be brought back

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1 There have been several LOSA conferences in different regions of the world. At these events, airline representatives learn about Threat and Error Management, they hear from other airlines who have implemented a LOSA, and they attend an overview of LOSA observer training using the TEM model.
in after one or two flights, to discuss their observations, correct any misperceptions, and coach them on areas that require clarification.

9. **Schedule observations**

Plan no more than two observations per observer per day to allow sufficient time to complete the observation form and write a rich narrative. Schedule observers across fleets regardless of their type rating to encourage a more general, cross-fleet perspective of flight crew performance. Build some flexibility into the schedule to allow for the unexpected. Finally, do not let the observations continue indefinitely—schedule all observations within a 1-3 month period if possible, else the impact of LOSA will be lost.

10. **Decide on a data repository**

The LOSA coordinator organizes a secure site for the data and oversees the receipt of the observation forms. The coordinator must be able to protect the identity of the observers and the observed to ensure complete confidentiality and non-jeopardy conditions. Under no circumstances should it be possible to connect individuals with particular observations.

The observations can be kept in-house if data management and analysis expertise is available, and if data security can be assured. Alternately, the data can be sent to a trusted third party who will assume responsibility for data collection, cleaning, and analysis. The decision will depend on airline resources and pilot trust issues.

11. **Provide logistical support**

Give the observers the name of a contact person, most likely the LOSA coordinator, who can be reached if there are any problems with scheduling or data collection.

**DATA ANALYSIS & FEEDBACK**

12. **Verify the data**

Convene a meeting of “local experts”—airline personnel familiar with the operation of each fleet (possibly fleet managers or member of the steering committee, but not any of the observers). The group’s task is to review and verify the observations against current manuals, policies, and procedures. For example, an observer might log a procedural error for failure to make an approach callout when in fact there is no written procedure in the airline’s flight operations manual. The data verification group would delete this particular ‘error’ from the database. This step is a data integrity check in that it ensures that events are correctly recorded in line with each fleet’s procedures and policies. It also builds ownership in the results and dispels any later criticism that the coding was not an accurate representation of the airline’s operations.

13. **Analyze data**

LOSA data reveal strengths and vulnerabilities in an airline’s operations. The data analyst should investigate the prevalence and management of different events and
errors. Although certain types of comparisons will seem obvious, many analyses can and should be based upon hunches and theories derived from local knowledge of operations. If the analyst knows how fleets and operations are managed, comparisons that reflect this structure can be made. If the analyst knows the kinds of information that might be useful to training, safety, or to domestic or international flight operations, results can be tailored to these particular aspects of the operation. Feedback from various airline stakeholders is critical during this stage of preparing the report. The analyst should not hesitate to distribute early drafts to key people within the airline familiar with LOSA to cross-verify the results. This not only helps validate derived trends, but it gives other airline personnel ownership of the report.

Patterns will emerge as the data are analyzed. Certain errors occur more frequently than others, certain airports or events emerge as more problematic than others, certain SOPs are routinely ignored or modified, and certain maneuvers pose greater difficulty for adherence than others. These events and practices form the basis of suggested targets for enhancement.

14. Prepare report

The last stage of a LOSA is a written report that presents the overall findings of the audit. With a large database like the one generated from a LOSA, it is easy to fall into the trap of trying to present everything. The report must be concise and present only the most significant trends from the data.

Along with the results, the report should provide an initial list of targets for enhancement. Targets need to be action-focused and data-driven. Some example targets that might emerge from a LOSA include:

- Reduce the number of unstabilized approaches
- Streamline pre-departure checklists
- Reduce SOP cross-verification errors
- Understand automation errors on the new fleet
- Investigate conditions at airports X and Y
- Improve management of adverse weather threats
- Investigate high rate of MEL items on the ZZ fleet
- Reduce dispatch errors at the hub
- Develop an international flight operations guide
- Develop a module on intentional non-compliance errors for Captain Upgrade training

15. Brief management

The LOSA report should be presented to management in operations, training, standards, safety, and possibly other departments depending on the results. For example, representatives from ramp, maintenance, dispatch and cabin may want
to hear how their work is perceived from the pilots’ perspective, particularly if it is problematic. A briefing to the pilots’ association is also recommended.

Once the various departments are briefed on the report, they will likely want to investigate the data more deeply themselves. The data should be available in aggregated form for them to review. Some flight narratives will also be of interest, hence the prerequisite insistence on de-identifying the observations.

16. Brief line pilots

Line pilots should also be informed of the significant results in the LOSA report. To sustain the pilots’ interest in the LOSA project, make an announcement at the end of the data collection phase that the LOSA observations have been completed, stating how many and on what fleets, and advise when the pilots can expect to see the results.

When the report is ready, the highlights should be presented to the pilots, either as one LOSA debriefing event or spread over time in the airline newsletter or other safety periodical. Pilots will want to know what changes will be undertaken as a result of the LOSA.

17. Monitor safety change process

Historically, organizational safety changes within airlines have been driven by accident/incident investigation and intuition. Today, airlines must deal proactively with accident and incident precursors. To be successful, the safety change process must be data-driven. Measurement of daily operations is fundamental, because unless an organization uses systematic measurement, the perspective it has on the strengths and weaknesses of its operations is largely based on anecdote and opinion.

A LOSA provides specific and quantified results. To take full advantage of this specificity, the targets for enhancement that arise from the data analysis should go through a formal safety change process to produce improvement. A formal safety change process provides a principled approach to target limited resources and helps the airline avoid “turf” issues, by clearly defining and prioritizing the issues that impact flight operations. The basic steps of a safety change process are:

- Measurement (with LOSA) to obtain the targets;
- Detailed analysis of targeted issues;
- List of potential changes for improvement;
- Risk analysis and prioritization of changes;
- Selection and funding of changes;
- Implementation of changes;
- Time for changes to stabilize;
- Re-measurement.
HOW TO USE LOSA DATA

A well-conducted and well-analyzed LOSA identifies strengths and vulnerabilities in an airline’s operations. It provides this information in a quantifiable form against which targets can be specified and improvements can be measured. The following example briefly illustrates the step-by-step integration of LOSA data into the safety change process.

An airline’s LOSA results indicate that 16% of observed flights involved an unstable approach. Because observations were scheduled across the operation, and the number of observations exceeded 50 per fleet, the LOSA committee is confident that the percentage is an accurate representation of operations as a whole.

Following management briefings and extensive discussion, a specific target for improvement is created to “reduce the number of unstabilized approaches by 50%, that is, reduce the number of unstable approaches from 16% to 8% or fewer of all landings.”

An action committee is formed for unstabilized approaches. They formalize the parameters and definition of an unstable approach, they review existing procedures and training, and they introduce changes in all relevant areas.

A repeat LOSA is conducted three years after the first LOSA. The data, once aggregated and analyzed, show the new rate of unstable approaches to be 12%. The airline concludes that changes made to the operation were successful in reducing the rate of unstabilized approaches from 16% to 12%, an improvement of 25%. Upon reviewing the results of the second LOSA, the airline recommits to its original target of reducing the unstable approach rate to 8% or lower, and continues to focus efforts in this area.

Depending on the sophistication of an airline’s safety management system, and the extent to which different safety programs within the airline are premised on the same conceptual framework, data from a LOSA can be cross-referenced with data from the ASAP or FOQA programs. Each data source provides unique yet complementary evidence of the airline’s safety status. In the above example, the airline might track unstable approaches through its FOQA program using new flight parameters decided by the action committee and then implemented into procedures and training. To see if pilots are incurring problems with the new procedure, the FOQA aircraft data can be cross-referenced with ASAP reports of events resulting from unstable approaches. This way, the airline does not have to wait until the next LOSA to learn if its interventions are being successful.

LOSA data are useful in another way. LOSA presents a broad view of operations; a repeat LOSA can maintain that broad focus. For example, did the changes that were introduced after the first LOSA improve results in one area, only to cause problems in another? Checklist adherence may have improved, but did error detection—the superordinate goal of improving checklist adherence—actually improve or is the new adherence simply cosmetic?
SUMMARY: THE TEN OPERATING CHARACTERISTICS OF LOSA

Ten operating characteristics define and summarize the LOSA process. Under the guidance of this Advisory Circular, a LOSA must observe all ten characteristics to ensure the integrity of the LOSA process and the quality of the final product. These ten characteristics have been formally endorsed by ICAO, IATA, and US ALPA.

The Ten Operating Characteristics are:

1. **Jump-seat observations during normal flight operations**
   LOSA observations are limited to regularly scheduled flights. Line checks, initial line indoctrination or other training flights are off-limits due to the extra level of stress put on pilots during this type of situation. Having another observer on board adds to an already high stress level, thus providing an unrealistic picture of performance. In order for the data to be representative of normal operations, LOSA observations must be collected on regular and routine flights.

2. **Joint management/pilots’ association sponsorship**
   In order for LOSA to succeed as a viable safety project, there needs to be support not only from the management side but also from the pilots. The joint sponsorship provides a “check and balance” for the project to ensure that change, as necessary, will be made as a result of LOSA data. When considering whether to conduct a LOSA, the first question to be asked by airline management is whether the pilots’ association (or pilot group representatives) endorses the project. If the answer is “No”, the project must not be initiated until endorsement is obtained.

3. **Voluntary crew participation**
   Maintaining the integrity of LOSA within an airline and the industry as whole is extremely important for long-term success. To accomplish this goal, all LOSA observations are collected with voluntary crew participation. Before conducting LOSA observations, observers must first ask the flight crew for permission to be observed. If the crew declines, the observer takes another flight with no questions asked. If an airline conducting a LOSA has an unreasonably high number of declines, this should serve as an indicator that there are critical “trust” issues to be resolved.

4. **De-identified, confidential, and non-disciplinary data collection**
   LOSA observers are required not to record names, flight numbers, dates, or any other information that can identify a crew or individual. The purpose of LOSA is to collect safety data, not to punish pilots. Airlines cannot allow themselves to squander a unique opportunity to gain insight into their operations by having pilots fearful that a LOSA observation could be used against them for disciplinary reasons. If a LOSA observation is ever used for disciplinary reasons, the credibility of the entire safety program may be irreparably compromised.
5. **Targeted observation instrument**

The LOSA observation form is predicated on the TEM framework. At the airline’s own initiative (and risk), other conceptual frameworks can be used for LOSA data collection. Whatever framework is used, it must generate meaningful data on a variety of topics, including what the crews did well, what they did poorly, and how they managed each phase of flight. A narrative written by the observer should have sufficient detail to allow others to understand the flight and all its events. The observers need to describe the environmental conditions and events surrounding the pilots’ behavior so that the crews’ performance can be understood in full context.

6. **Trained and calibrated observers**

Primarily, pilots conduct LOSA. Observation teams will typically include line pilots, instructor pilots, safety pilots, management pilots, and representatives of the pilots’ safety committee. It is critical to select observers that are respected and trusted within the airline to ensure line acceptance of LOSA. After observers are selected, they are trained and calibrated in the LOSA methodology, including the use of the LOSA observation forms. Observers’ training in the concepts and methodology of LOSA will ensure that the observations will be conducted in the most standardized manner.

7. **Trusted data repository**

In order to maintain confidentiality, airlines must have a trusted data repository. This site can be in-house, such as that used for other confidential data such as FOQA, or it can be off-site. The goal is that no individual observations will be misplaced or improperly disseminated through the airline.

8. **Data verification**

Data-driven programs like LOSA require quality data management procedures and consistency checks. For LOSA, these checks are done at data-verification roundtables. A roundtable consists of three or four department and pilots’ association representatives who review all the raw data for possible inaccuracies. The end product is a database that is validated for consistency and accuracy according to the airline’s standards and manuals, before any statistical analysis is performed.

9. **Targets for enhancement**

The final product of a LOSA is the data-derived targets for enhancement based on emergent patterns in the data. It is then up to the airline to develop an action plan based on these targets, using experts from within the airline to analyze the targets and implement appropriate change strategies.

10. **Feedback results to the line pilots**

In order to ensure long-term success of LOSA, airlines must communicate the results back to the line pilots. Pilots will want to see not only the results of the audit, but also management’s plan for improvement.
APPENDIX A: THREAT AND ERROR MANAGEMENT (TEM): MODEL AND APPLICATIONS

Introduction
The Threat and Error Management (TEM) model is a conceptual framework for understanding operational performance in complex environments. Originally created to capture the flight crew’s task in commercial aviation, the model is generic and can be applied to numerous work situations. The added value that TEM brings to other performance models is that it focuses simultaneously on the operating environment and the humans working in that environment. Because the model captures ongoing performance in its “natural” or normal operating context, the resulting description is realistic, dynamic, and holistic. Because the model can also quantify the specifics of the environment and the effectiveness of performance in that environment, it is also highly diagnostic.

There are several ways of using the TEM model, from focusing on a single event (as is the case with accident/incident analysis) to understanding systemic patterns in a large set of events (as with LOSA). As a training tool, TEM can help individuals clarify their performance needs and vulnerabilities, and as part of a safety management system, TEM can help an organization measure and improve the effectiveness of its organizational defenses and safeguards.

The Model
This section defines and provides examples of the various components of the Threat and Error Management (TEM) model.

Threats
A threat is defined as an event or error that occurs outside the influence of the flight crew, (that is, it was not caused by the crew), increases the operational complexity of a flight, and requires crew attention and management if safety margins are to be maintained.

There are threats from the environment—adverse weather, airport conditions, terrain, traffic, and ATC—and threats emanating from within the airline—aircraft malfunctions and MEL items, problems, interruptions, or errors from dispatch, cabin, ground, maintenance, and the ramp. Threats may be anticipated by the crew, for example, by briefing a thunderstorm in advance, or they may be unexpected, occurring suddenly and without warning such as in-flight aircraft malfunctions. Some threats are easily resolved and quickly dismissed from the crew’s workload, while other threats require greater attention and management. A mismanaged threat is defined as a threat that is linked to or induces flight crew error.

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2 The rest of this appendix will talk about TEM exclusively in the aviation environment so as to provide specific examples and situations. However, it is important to remember that the TEM framework can be applied to other high-risk industries and jobs. To do so requires task and situational analyses by subject matter experts to develop the relevant threat and error taxonomies.
Errors

Crew error is defined as action or inaction that leads to a deviation from crew or organizational intentions or expectations. Errors in the operational context tend to reduce the margin of safety and increase the probability of adverse events.

Broadly speaking, there are handling errors (flight controls, automation), procedural errors (checklists, briefings, callouts) and communication errors (with ATC, ground, or pilot-to-pilot). See the error management worksheet in the sample observation form, Appendix C, for a more complete list of errors.

Understanding how the error was managed is as important, if not more important, than understanding the prevalence of different types of error. It is of interest then if and when the error was detected and by whom, as well as the response(s) upon detecting the error, and the outcome of the error. As with threats, some errors are quickly detected and resolved, leading to an inconsequential outcome, while others go undetected or are mismanaged. A mismanaged error is defined as an error that is linked to or induces additional error or an undesired aircraft state.

Undesired Aircraft States

An undesired aircraft state (UAS) is defined as a position, condition or attitude of an aircraft that clearly reduces safety margins and is a result of actions by the flight crew. It is a safety-compromising state that results from ineffective error management. Examples include unstable approaches, lateral deviations, firm landings, and proceeding towards wrong taxiway/runway. (More examples are noted on the observation form in Appendix C.) Events such as equipment malfunctions or ATC command errors can also place the aircraft in a compromised position, but these would be considered threats.

As with errors, UAS’s can be managed effectively, returning the aircraft to safe flight, or the crew action or inaction can induce an additional error, incident, or accident.

Threat and Error Countermeasures

A description of a flight is not complete without noting what the crew was doing to anticipate threats and avoid errors, as well as managing those that occurred. The following crew behaviors are considered threat and error countermeasures:

- Planning countermeasures—planning, preparation, briefings, contingency management—are essential for managing anticipated and unexpected threats
- Execution countermeasures—monitor/cross-check, taxiway/runway management, workload and automation management—are essential for error detection and error response
- Review/Modify countermeasures—evaluation of plans, inquiry—are essential for managing the changing conditions of a flight

Figure 1 is a graphic summary of the Threat and Error Management model.
In sum, the TEM model captures the dynamic activity that is a flight crew planning and executing a flight in real time and under real conditions. The utility of the model is that it can be applied proactively or reactively, at the individual, organizational, and/or systemic levels.

**Practical Applications of the TEM model**

**TEM as a training tool**

TEM is the foundation of human factors training programs at several airlines; including Continental, Delta, US Airways, Frontier, Cathay Pacific, EVA Air, Air New Zealand, and Singapore Airlines. TEM training emphasizes the value of threat anticipation and management, error avoidance, and error detection and recovery. The model allows pilots to analyze their own performance strengths and vulnerabilities. The International Civil Aviation Organization has adopted the TEM model in its Human Factors Training Manual (ICAO Document 9683), produced in 2002 to help airlines design human factors curricula.

TEM concepts can be trained effectively in the classroom in the absence of LOSA. However, TEM training can be enhanced if an airline has also conducted a LOSA. The LOSA results can help shape the training curriculum, and pilots can discuss the findings...
during training. Pilots are always interested in and respond well to data derived from their own operation.

**TEM as a reporting tool for incidents**

TEM has been integrated into the Aviation Safety Action Program (ASAP) of several US airlines, including Continental, Frontier, and Northwest Airlines. Reporting forms structured to the TEM framework instruct the pilots to describe the event at the level of threats and errors. The TEM format prompts pilots to report information about the threats that were present, the errors they may have made, how well the event was managed, and how the event may have been avoided or handled better. Preliminary work has shown that even pilots who have not had training in the TEM model are able to complete the reporting form, a fact that speaks to the intuitive nature of the TEM framework.

In the ASAP environment, TEM can “go inside the pilot’s head” in a way that LOSA as an objective observational tool cannot do and most assuredly does not want to do. With ASAP, pilots can report personal or historical factors that contributed to the event – information that is not privy to an observer. With LOSA, the benefit is that observers may detect threats and errors that the crews themselves do not detect. This is one example of how LOSA and ASAP data can complement each other at the system level.

**TEM as a systematic observation tool**

The TEM model was first conceived in conjunction with the development of LOSA; hence, its original application was as an observation tool (See Appendix B: Evolution of LOSA.) Feasibility studies are currently underway to explore the transfer of the methodology to airline flight dispatch and air traffic control. In 2002, Continental Airlines began exploring an adapted version of LOSA called Dispatch Operations Safety Audit (DOSA). Early results demonstrated that such a transfer of methodology is possible and could ultimately provide a 360-degree perspective on the interaction between pilots and dispatchers. In addition, ICAO has instituted a formal group of ATC subject matter experts from across the world to develop the Normal Operations Safety Survey (NOSS), a formal protocol to observe normal operations in ATC, based on the TEM model and LOSA methodology.

**TEM as a reactive analysis tool for accidents and incidents**

TEM can be used as an analysis tool to understand rare events, such as accidents and serious incidents. The IATA Safety Committee (SAC) has adopted the TEM model as an analysis framework for its Incident Review Meetings, based on its ease of use and utility of the extracted data.

**TEM as a proactive analysis tool**

When TEM is used as the framework for safety data collection, a wealth of information can be extracted. An airline can use the data to understand patterns at the organizational level. The data can also be collected across the industry and analyzed for systemic trends.

An analysis based on TEM can:
Quantify those aspects of the working environment that can pose a problem for the efficiency or safety of the operation (threat prevalence);

Quantify the management of those threats as either effective or ineffective (threat management);

Recognize high rates of threat prevalence and mismanagement as systemic vulnerabilities;

Codify and quantify the errors that crews commit (error prevalence);

Codify and quantify the error management process from diagnosis to response and outcome (error management);

Recognize high rates of error prevalence and error mismanagement as systemic flaws in procedures, policies, training, aircraft design, and or inter-agency coordination; and

Locate strengths as well as vulnerabilities in organizational safeguards.

Conclusion

The TEM model is intuitive, practical, and versatile. More and more airlines are realizing the utility of TEM, as exemplified in the following quote from an airline manager:

“Since our LOSA, we have introduced a one-day TEM course for our pilots. The overwhelming response has been positive, and there's a recognition among pilots that in TEM, the academic community is using language we understand and feel. Additionally we are using TEM as a de-briefing tool for training events. Once again this makes sense to the pilots, and the common reaction is one of dawning; penny-dropping; eureka!”
APPENDIX B: THE EVOLUTION OF LOSA

LOSA’s roots can be traced to a 1994 collaboration between Delta Air Lines and The University of Texas Human Factors Research Project (UTHF). After developing a new Crew Resource Management (CRM) course for their pilots, Delta’s management sought to verify whether the concepts presented in training transferred to line operations. The only perspective Delta’s management had on CRM performance at the time was gathered from training data, such as those from the Line Oriented Flight Training (LOFT) program and line checks. Delta’s management felt that these data were good at uncovering proficiency issues but were uncertain whether they reflected the actual practice of CRM on the line. This question prompted a partnership between UTHF and Delta to develop a line audit methodology utilizing jump-seat observations on regularly scheduled flights to gather an operational snapshot of CRM in practice.

The audit collected over 400 observations using behavioral indicators of CRM skills with guarantees of confidentiality and no regulatory or organizational jeopardy for crews observed. The audit was a success on both the operational and research fronts. From the operational perspective, it provided Delta with a baseline of CRM strengths and weaknesses that supplemented training data and allowed management to better prioritize improvements in their CRM program. From the research perspective, access to such data allowed UTHF to uncover CRM performance issues on the line, which were presented to the aviation community through publications between 1994 and 1997. Based on the success of the Delta experience, other airlines, including TWA, American Airlines, and US Airways, also conducted CRM audits in collaboration with UTHF.

The mid to late 1990’s marked the inception of a systems approach to safety and human error research in aviation. Work conducted by Professor James Reason, at the University of Manchester in England, inspired UTHF to modify the existing line audit methodology to incorporate human error research. After examining narratives from previous audits, the project began to develop early versions of a model to provide a principled basis for data collection on operational errors. The model initially focused on error avoidance, error resistance and error management. Subsequent iterations of the model focused on capturing operational complexity via environmental and airline threats in addition to errors, and later, undesired aircraft states, thus leading to the Threat and Error Management (TEM) Model. Instead of collecting CRM performance in isolation, observers now recorded all observed threats and errors and their management, as well as undesired aircraft states and their management. This led to the current LOSA methodology.

In collaboration with Continental Airlines in 1996, the first threat and error management LOSA, aimed at capturing the operational context within which Continental flight crews performed daily, was conducted. The project was deemed a success and in 2000, Continental decided to conduct another LOSA as a way to benchmark their safety improvements. Continental Airlines thus effectively provided the “proof of concept” for LOSA, which transformed it from a research method to a safety tool for airlines. The Continental LOSA success story was recognized by the International Civil Aviation Organization (ICAO), which immediately made it a central focus of its Flight Safety and Human Factors Program and endorsed it through an official document (*ICAO LOSA*)
Manual, Doc 9803) as an industry best practice for normal operations monitoring. As a result, LOSA is known in all regions of the world. At the time of writing this Advisory Circular (September 2004), over twenty airlines inside and outside the United States have completed a LOSA following the procedural protocol outlined in this document.

The LOSA methodology has matured in concert with the Threat and Error Management model, leading to wider applications of TEM and greater utility of the LOSA method. Originally conceived to observe CRM performance on the line, the LOSA methodology now goes well beyond pilot performance. Because LOSA captures the process of flight management in full operational context, it can now take its place alongside electronic data capture systems (i.e., FOQA) and voluntary reporting systems (i.e., ASAP). These three data-collection programs together support an airline’s integrated safety management system.
APPENDIX C: SAMPLE LOSA OBSERVATION FORM

**LOSA Observation Form**

**Observer Information**

| Observer ID (Employee number) | 3059 | Observation Number | #1 |

**Crew Observation Number**

(e.g., "1 of 2" indicates segment one for a crew that you observed across two segments)

| 1 | of | 1 |

**Flight Demographics**

| City Pairs (e.g., PIT-CLT) | PIT - LAX |
| A/C Type (e.g., 737-300) | B-757 |
| Pilot flying (Check one) | CA | FO | X |

| Time from Pushback to Gate Arrival (Hours:Minutes) | 4:55 |
| Local Arrival Time (Use 24 hour time) | 09:55 |

**Late Departure? (Yes or No)**

| Yes |

**Predeparture / Taxi**

**Narrative**

The CA established a great team climate - positive with open communication. However, he seemed to be in a rush and not very detail oriented. The FO, who was relatively new to the A/C, tried to keep up but fell behind at times. The CA did not help the cause by interrupting the FO with casual conversation (marginal workload management).

All checklists were rushed and poorly executed. The CA was also lax verifying paperwork. This sub-par behavior contributed to an undetected error - the FO failed to set his airspeed bugs for T/O (poor monitor/cross-check). The Before Takeoff Checklist should have caught the error, but the crew unintentionally skipped over that item. The FO noticed the error upon commencing the takeoff roll and said, "Missed that one."

The Captain’s brief was interactive but not very thorough (marginal SOP briefing). He failed to note the closure of the final 2000’ of their departing runway (28R) due to construction. Taxiways B7 and B8 at the end of the runway were also out. The crew was marked “poor” in contingency management because there were no plans in place on how to deal with this threat in the case of a rejected takeoff. Lucky it was a long runway.
# Takeoff / Climb

<table>
<thead>
<tr>
<th>Narrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your narrative should provide a context. What did the crew do well? What did the crew do poorly? How did the crew manage threats, crew errors, and significant events? Also, be sure to justify your behavioral ratings.</td>
</tr>
</tbody>
</table>

Takeoff was normal. ATC granted a right turn VFR climb which was commenced at 600 ft. Climb to flight level 20000 with step climbs to 35000 ft. Eventually leveled at 31000 ft about 90 miles North. When established at FL200, ATC cleared the crew to FL270. They accepted and the First Officer dialed 230 instead of 270 in the MCP. The Captain caught the error on cross-verification.

# Cruise

<table>
<thead>
<tr>
<th>Narrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your narrative should provide a context. What did the crew do well? What did the crew do poorly? How did the crew perform during the handover?</td>
</tr>
</tbody>
</table>

Crew stayed attentive to aircraft position throughout cruise.
<table>
<thead>
<tr>
<th>Narrative</th>
<th>Your narrative should provide a context. What did the crew do well? What did the crew do poorly? How did the crew perform during the handover?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Briefing to TOD</strong> - The approach brief much better than their takeoff brief. They expected runway 25L from the Citet Arrival for a straight-in visual approach. Jepp charts were out, contingencies talked about, and everything was by the book (outstanding SOP brief and plans stated).</td>
<td></td>
</tr>
<tr>
<td><strong>10000’ to slowing and configuring</strong> - ATC cleared the crew to 25L, but at 8000’, ATC changed us to the Mitts Arrival for runway 24R due to a slow moving A/C on 25L. The CA changed the arrival and approach in the FMC, tuned the radio, and quickly briefed 24R. As soon as everything was clean, ATC called back and told the crew they could either land on 25L or 24R at their discretion. Since time was a factor, the crew discussed and decided to stick with the approach into 24R. The crew was flexible and the CA did a nice job assigning workload. FO flew the plane while the CA checked everything over one more time (outstanding evaluation of plans). The crew was also better monitors and cross checkers. However, their execution of checklists was still a little sloppy – late and rushed (marginal monitor and cross check).</td>
<td></td>
</tr>
<tr>
<td><strong>Bottom lines to Flare / Touchdown</strong> - The approach was stable, but the FO let the airplane slip left, which resulted in landing left of centerline. Since the FO was new to this aircraft (1 month flying time), the observer chalked it up to a lack of stick and rudder proficiency.</td>
<td></td>
</tr>
<tr>
<td><strong>Taxi-in</strong> - The crew did a great job navigating taxiways and crossing the active 24L runway. Charts were out and both heads looking for traffic. (outstanding taxiway / runway management). However, there were no wing walkers meeting the aircraft in a congested ramp area. A common problem in LAX.</td>
<td></td>
</tr>
</tbody>
</table>

**Overall Flight**

<table>
<thead>
<tr>
<th>Narrative</th>
<th>This narrative should include your overall impressions of the crew.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall, the crew did a marginal job with planning and review/modify plans during predeparture. However, during the descent/approach/land phase, it was excellent. Their execution behaviors were marginal to good for the entire flight.</td>
<td></td>
</tr>
<tr>
<td>While the takeoff brief was marginal, the CA made an outstanding approach brief. Open communication was not a problem. Good flow of information when the flight’s complexity increased with the late runway change. They really stepped it up.</td>
<td></td>
</tr>
</tbody>
</table>
| During predeparture, the CA introduced an unnecessary element of being rushed, which compromised workload management. However, his decisiveness and coordination in the descent/approach/land phase kept his leadership from being marked "marginal."

The big knock against this crew involved checklists, cross verifications, and all monitoring in general. They were a little too complacent during low workload periods (e.g., No altitude verifications during climb). The CA set a poor example in this regard. When the workload increased, the crew did a good job. |
<table>
<thead>
<tr>
<th>Threat ID</th>
<th>Threat Description</th>
<th>Threat Type</th>
<th>Phase of Flight</th>
<th>Linked to flight crew error?</th>
<th>How did the crew manage or mismanage the threat?</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Runway and taxiway construction on their departing runway (final 2000')</td>
<td>103</td>
<td>1</td>
<td>No</td>
<td>Threat mismanaged - CA failed to include the construction and closures in his brief. No plans were made in the event of a rejected takeoff, which is required by airline SOP.</td>
</tr>
<tr>
<td>T2</td>
<td>Late ATC runway change - changed runway to 24R from 25L due to a slow moving aircraft on 25L</td>
<td>101</td>
<td>4</td>
<td>Yes</td>
<td>Threat managed - CA reprogrammed the FMC, handled the radios, and placed emphasis on the FO to fly the aircraft.</td>
</tr>
<tr>
<td>T3</td>
<td>After a late runway change, ATC called back and told the crew that it was at their discretion to land on 24R or 25L</td>
<td>101</td>
<td>4</td>
<td>Yes</td>
<td>Threat managed - CA asked for the FO’s preference. They mutually decided to continue the approach into 24R because it was already in the FMC.</td>
</tr>
<tr>
<td>T4</td>
<td>On taxi-in, there were no wing walkers meeting the aircraft in a congested ramp area in LAX</td>
<td>204</td>
<td>5</td>
<td>Yes</td>
<td>Threat managed - The crew called ground ops and wing walkers were dispatched to the airplane</td>
</tr>
<tr>
<td>T5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Threat Codes**

<table>
<thead>
<tr>
<th>Environmental Threats</th>
<th>Airline Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Adverse Weather</td>
<td>200 Airline Operational Pressure</td>
</tr>
<tr>
<td>101 ATC</td>
<td>201 Cabin</td>
</tr>
<tr>
<td>102 Terrain</td>
<td>202 Aircraft Malfunctions / MEL Items</td>
</tr>
<tr>
<td>103 Airport Conditions</td>
<td>203 Ground Maintenance</td>
</tr>
<tr>
<td>104 Heavy traffic (air or ground)</td>
<td>204 Ground / Ramp</td>
</tr>
<tr>
<td>199 Other Environmental Threats</td>
<td>205 Dispatch / Paperwork</td>
</tr>
<tr>
<td>299 Other Environmental Threats</td>
<td>206 Manuals / Charts</td>
</tr>
</tbody>
</table>

27
## Error Management Worksheet

<table>
<thead>
<tr>
<th>Error ID</th>
<th>Describe the crew error</th>
<th>Phase of flight</th>
<th>Linked to threat?</th>
<th>Error Type</th>
<th>Crew Error Response</th>
<th>Error Outcome</th>
<th>Error Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>CA failed to brief a rejected takeoff for shortened departing runway due to construction.</td>
<td>1</td>
<td>T1</td>
<td>403</td>
<td>2</td>
<td>1</td>
<td>No error management.</td>
</tr>
<tr>
<td>E2</td>
<td>FO failed to set his airspeed bugs.</td>
<td>1</td>
<td></td>
<td>304</td>
<td>2</td>
<td>3</td>
<td>Linked to error #3</td>
</tr>
<tr>
<td>E3</td>
<td>In running the Before Takeoff Checklist, the FO skipped the takeoff data item.</td>
<td>1</td>
<td></td>
<td>401</td>
<td>2</td>
<td>2</td>
<td>Linked to UAS #1</td>
</tr>
<tr>
<td>E4</td>
<td>At FL200, the crew was cleared to FL270. They accepted and the FO dialed 230 instead of 270 in the Mode Control Panel.</td>
<td>2</td>
<td></td>
<td>302</td>
<td>1</td>
<td>1</td>
<td>Error managed - Captain caught the error on cross-verification.</td>
</tr>
<tr>
<td>E5</td>
<td>FO, hand flying, let the airplane slip a little to the left during the final approach.</td>
<td>4</td>
<td></td>
<td>300</td>
<td>2</td>
<td>2</td>
<td>Linked to UAS #2</td>
</tr>
</tbody>
</table>

### Error Type Codes

<table>
<thead>
<tr>
<th>Aircraft Handling</th>
<th>Procedural</th>
<th>Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 Manual Flying</td>
<td>400 SOP Cross-verification</td>
<td>500 Crew to External Communication</td>
</tr>
<tr>
<td>301 Flight Control</td>
<td>401 Checklist</td>
<td>501 Crew to Crew Communication</td>
</tr>
<tr>
<td>302 Automation</td>
<td>402 Callout</td>
<td>599 Other Communication</td>
</tr>
<tr>
<td>303 Ground Handling</td>
<td>403 Briefing</td>
<td></td>
</tr>
<tr>
<td>304 Systems / Instruments / Radios</td>
<td>404 Documentation</td>
<td></td>
</tr>
<tr>
<td>399 Other Aircraft Handling</td>
<td>499 Other Procedural</td>
<td></td>
</tr>
</tbody>
</table>
### Undesired Aircraft State (UAS) Management Worksheet

<table>
<thead>
<tr>
<th>UAS ID</th>
<th>Linking Error? (Enter the Error ID)</th>
<th>UAS Description</th>
<th>UAS Code</th>
<th>Crew UAS Response</th>
<th>UAS Outcome</th>
<th>UAS Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>UAS 1</td>
<td>E2</td>
<td>Wrong airspeed bugs on takeoff roll</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Errors mismanaged – The bug error should have been caught with the Before Takeoff Checklist, but the FO missed the item. The FO detected and corrected the error on the roll.</td>
</tr>
<tr>
<td>UAS 2</td>
<td>FO landed left of the centerline.</td>
<td>86</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Error mismanaged – FO tried to correct but still landed left of the centerline. Approach was stable and made the first high-speed taxiway.</td>
</tr>
</tbody>
</table>

### Undesired Aircraft State Type Codes

#### Configuration States
- 1 Incorrect A/C configuration - flight controls, brakes, thrust reversers, landing gear.
- 2 Incorrect A/C configuration – systems (fuel, electrical, hydraulics, pneumatics, air-conditioning, pressurization, instrumentation)
- 3 Incorrect A/C configuration – automation
- 4 Incorrect A/C configuration - engines

#### Ground States
- 20 Proceeding towards wrong runway
- 21 Runway incursion
- 22 Proceeding towards wrong taxiway / ramp
- 23 Taxiway / ramp incursion
- 24 Wrong gate
- 25 Wrong hold spot
- 26 Abrupt aircraft control - taxi

#### Approach / Landing States
- 80 Crew induced deviation above G/S or FMS path
- 81 Crew induced deviation below G/S or FMS path
- 82 Unstable approach
- 83 Continued landing - unstable approach
- 84 Firm landing
- 85 Floated landing
- 86 Landing off C/L
- 87 Long landing outside TDZ
- 88 Landing short of TDZ
- 99 Other Undesired States

#### Undesired Aircraft State Type Codes

- **Configuration States**
  - 1 Incorrect A/C configuration - flight controls, brakes, thrust reversers, landing gear.
  - 2 Incorrect A/C configuration – systems (fuel, electrical, hydraulics, pneumatics, air-conditioning, pressurization, instrumentation)
  - 3 Incorrect A/C configuration – automation
  - 4 Incorrect A/C configuration - engines

- **Ground States**
  - 20 Proceeding towards wrong runway
  - 21 Runway incursion
  - 22 Proceeding towards wrong taxiway / ramp
  - 23 Taxiway / ramp incursion
  - 24 Wrong gate
  - 25 Wrong hold spot
  - 26 Abrupt aircraft control - taxi

- **Aircraft Handling States – All Phases**
  - 40 Vertical deviation
  - 41 Lateral deviation
  - 42 Unnecessary WX penetration
  - 43 Unauthorized airspace penetration
  - 44 Speed too high
  - 45 Speed too low
  - 46 Abrupt aircraft control (attitude)
  - 47 Excessive banking
  - 48 Operation outside aircraft limitations

- **Approach / Landing States**
  - 80 Crew induced deviation above G/S or FMS path
  - 81 Crew induced deviation below G/S or FMS path
  - 82 Unstable approach
  - 83 Continued landing - unstable approach
  - 84 Firm landing
  - 85 Floated landing
  - 86 Landing off C/L
  - 87 Long landing outside TDZ
  - 88 Landing short of TDZ
  - 99 Other Undesired States
# Crew Performance Marker Worksheet

<table>
<thead>
<tr>
<th></th>
<th>Poor</th>
<th>Marginal</th>
<th>Good</th>
<th>Outstanding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Observed performance had safety implications</td>
<td>Observed performance was adequate but needs improvement</td>
<td>Observed performance was effective</td>
<td>Observed performance was truly noteworthy.</td>
</tr>
</tbody>
</table>

## Phase of Flight Ratings

<table>
<thead>
<tr>
<th>Planning Performance Markers</th>
<th>Predeparture / Taxi</th>
<th>Takeoff / Climb</th>
<th>Descent / Approach / Land / Taxi</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SOP BRIEFING</strong></td>
<td>The required briefing was interactive and operationally thorough</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>PLANS STATED</strong></td>
<td>Operational plans and decisions were communicated and acknowledged</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td><strong>CONTINGENCY MANAGEMENT</strong></td>
<td>Crew members developed effective strategies to manage threats to safety</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

## Execution Performance Markers

<table>
<thead>
<tr>
<th>Execution Performance Markers</th>
<th>Predeparture / Taxi</th>
<th>Takeoff / Climb</th>
<th>Descent / Approach / Land / Taxi</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MONITOR / CROSS-CHECK</strong></td>
<td>Crew members actively monitored and cross-checked systems and other crew members</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>WORKLOAD MANAGEMENT</strong></td>
<td>Operational tasks were prioritized and properly managed to handle primary flight duties</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>VIGILANCE</strong></td>
<td>Crew members remained alert of the environment and position of the aircraft</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>AUTOMATION MANAGEMENT</strong></td>
<td>Automation was properly managed to balance situational and/or workload requirements</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>TAXIWAY / RUNWAY MANAGEMENT</strong></td>
<td>Crew members used caution and kept watch outside when navigating taxiways and runways</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

## Review / Modify Performance Markers

<table>
<thead>
<tr>
<th>Review / Modify Performance Markers</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EVALUATION OF PLANS</strong></td>
<td>4</td>
</tr>
<tr>
<td><strong>INQUIRY</strong></td>
<td>3</td>
</tr>
</tbody>
</table>

## Overall Performance Markers

<table>
<thead>
<tr>
<th>Overall Performance Markers</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMMUNICATION ENVIRONMENT</strong></td>
<td>3</td>
</tr>
<tr>
<td><strong>LEADERSHIP</strong></td>
<td>3</td>
</tr>
</tbody>
</table>
APPENDIX D: SAMPLE LETTER TO THE LINE PILOTS

To: All XX Airline Pilots
From: (Name) Senior Director, Flight Operations
      (Name) Director, Flight Training and Standards
      (Name) Director, Flight Safety and Quality Assurance
      (Name) Chairman, Pilots’ association Safety Committee
Subject: Line Operations Safety Audit (LOSA)

Beginning mid-October and continuing for approximately five weeks, this airline will conduct a Line Operations Safety Audit (LOSA). LOSA observations are no-jeopardy events, and all data are confidential and de-identified. LOSA data go directly to the XX Research Program for data entry and analysis.

We will use our own pilots to conduct cockpit jumpseat observations. Be assured that these observations are not checkrides. Although some LOSA observers may be check airmen, 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.

The ultimate customer of the audit is you, the line pilot. The audit should help us identify problem areas so that we can correct them and make your job easier. Did you ever see a procedure that could be done better, but didn’t feel like you had a way to feed that idea into the system for possible change? Are some procedures better than others as far as helping avoid, trap and mitigate errors? LOSA should help us identify the strengths and weaknesses of our crew procedures, and with that information, management is committed to making necessary changes to continually improve the way that we do business.

In short, we’re doing a LOSA so that we can improve the system to better support you. After the audit is completed, we’re committed to telling you how it went, and how we plan to make improvements.

Please extend your usual professional courtesies to the LOSA observation team, and thank you for your unfailing cooperation.

Sincerely,

(Name), Senior Director, Flight Operations
(Name), Director, Flight Training and Standards
(Name), Director, Flight Safety and Quality Assurance
(Name), Chairman, Pilots’ association Safety Committee