

BY RICK DARBY

Drawing the Line

A line operations safety audit at IranAir pinpoints safety issues and leads to solutions.

Data collected through the line operations safety audit (LOSA) process “have shown that the source of a large number of errors is the lack of efficient training” and that LOSA represents “the best information to improve training systems, crew resource management and flight proficiency checks, and to refine standard operating procedures,” according to Roohollah Khoshkhoo, one of the authors of a paper presented at the 64th annual International Air Safety Seminar, held in Singapore in November 2011.¹ A flight safety and operations quality expert at IranAir, he described the first LOSA conducted at the airline in 2009, its operational findings and their application to crew training for threat and error management. A second LOSA was conducted to determine the improvement since the first.

The authors compared LOSA with other proactive safety programs, quick access

recorder (QAR)/flight data recorder (FDR) analysis and line checks. “QAR/FDR [analysis] cannot identify human behavior or flight crew performance and environmental context; it also has a high cost-to-efficiency ratio,” they said. “The other method is the line check to evaluate pilots’ performance, and it can be punitive for pilots who fail. Therefore, pilots are under high pressure to fake qualification and capability. LOSA is non-jeopardy assurance for pilots. It avoids the weaknesses of the two other methods. LOSA is different from and complementary to other proactive safety programs.”

The authors said, however, that LOSA is only a tool for collecting data, not itself a solution: “After LOSA data collection, the organization must analyze the data, find problems to investigate and react in ways that improve safety.”

In the first LOSA, observed data were collected during three months. Following that, a LOSA steering committee checked the data and input them to analytical software. Based on the analysis, the committee devised goals for improving crews' ability to counter threats and avoid errors.

Threats are "uncontrollable external conditions for the flight crew and must be managed by them," the authors said. They are of two types — expected and unexpected. "Expected threats, like thunderstorms, can be anticipated by the flight crew," they said. "Unexpected threats, such as cargo loading error by ground staff, occur suddenly. The flight crew has no advance warning."

Errors are "crew actions that lead to a deviation from crew or organizational intentions or expectations." They come in three varieties: spontaneous; linked to threats; and an error chain that causes further errors. "Many errors are managed, but the others lead to another error or undesired aircraft state (UAS), possibly culminating in an accident," the authors said. UASs are either aircraft deviations or incorrect configuration.

"Threats must be recognized at the best time, because after an accident or incident it's too late to investigate threats," they said. "On the other hand, by LOSA most threats can be proactively identified."

At the time of the first LOSA, IranAir had mixed aircraft fleets including Boeing 727s and 747s, Airbus A300s, A310s and A320s, and Fokker 100s. "LOSA was undertaken on all fleets both on short-haul domestic and medium-haul international routes," the authors said. A minimum of 10 LOSA observations for each fleet were obtained in both the first and second LOSAs (Table 1).

In the first LOSA, 73 percent of flights involved at least one threat, with an average of 2.19 threats per flight. The greatest number of threats on one flight was seven.

Half the threats occurred during the preflight/taxi phase, the highest percentage (Table 2). In descending order of percentage, other threats occurred in descent/approach/

IranAir Weekly Departures During LOSA Observations				
Fleet	Number of Departures	Percentage of Flights	Number of Observations, First LOSA	Number of Observations, Second LOSA
Boeing 747	34	8.59	11	10
Airbus A310	47	11.9	15	15
Airbus A300	67	16.92	21	21
Airbus A320	22	5.5	10	10
Boeing 727	27	6.82	10	10
Fokker 100	199	50.26	65	60
Total	396	100 ¹	132	126

LOSA = line operations safety audit
Note:
 1. Individual percentages do not equal 100 because of rounding.
 Source: Roohollah Khoshkhoo et al., IranAir

Table 1

Threats in IranAir First LOSA, by Phase of Flight	
Phase of Flight	Percentage of Threats
Preflight/taxi	50
Takeoff/climb	15
Cruise	8
Descent/approach/landing	19
Taxi/parking	8

LOSA = line operations safety audit
 Source: Roohollah Khoshkhoo et al., IranAir

Table 2

Threats in IranAir First LOSA, by Type	
Threat Type	Percentage of Threats
Environmental	35
Adverse weather	11.5
Air traffic control	11.5
Other	12.0
Airline	65
Aircraft malfunction/MEL	30.7
Ground maintenance	14.0
Dispatch/paperwork	4.4
Other	15.9

LOSA = line operations safety audit; MEL = minimum equipment list
 Source: Roohollah Khoshkhoo et al., IranAir

Table 3

Errors in IranAir First LOSA	
Percentage of flights with at least one error	94
Average number of errors per flight	5.71
Most errors on one flight	20
Total number of errors	754
LOSA = line operations safety audit	
Source: Roohollah Khoshkhoo et al., IranAir	

Table 4

Errors in IranAir First LOSA, by Phase of Flight	
Phase of Flight	Percentage of Errors
Preflight/taxi	31.0
Takeoff/climb	9.0
Cruise	14.0
Descent/approach/landing	26.5
Taxi/parking	9.5
LOSA = line operations safety audit	
Note: This assignment of error to phase of flight represents 90 percent of errors.	
Source: Roohollah Khoshkhoo et al., IranAir	

Table 5

Error Types and Outcomes in IranAir First and Second LOSAs		
Error Type	Percentage of flight segments with at least one error, first LOSA	Percentage of flight segments with at least one error, second LOSA
Technical error		
SOP cross-verification	59.0	20
Briefing	36.5	12
Sterile cockpit	23.0	15
Checklist	17.0	9
Manual flying	15.0	9
Standard callout	11.5	7
Unstable approach	11.5	5
Non-technical error		
Crew-to-crew communication	46.0	30
LOSA = line operations safety audit; SOP = standard operating procedure		
Source: Roohollah Khoshkhoo et al., IranAir		

Table 6

landing, takeoff/climb and cruise, which was equal to taxi/parking.

Threat types in the first LOSA were analyzed according to whether they were associated with

the environment or the airline (Table 3). About one-third were environmental; two-thirds were airline-associated threats. Environmental threats were more or less equally divided among adverse weather, air traffic control and “other.” Airline-related threats were most often associated with aircraft malfunction or the minimum equipment list.

The first LOSA identified one or more flight crew errors on 94 percent of flights (Table 4), with as many as 20 errors on a single flight.

“It is obvious that the preflight/taxi-out and then descent/approach/landing phases [had] the most errors,” the authors said (Table 5).

“Based on the first LOSA results to detect threats and errors, some changes were made for improving and enhancing operational performance and training objectives,” the authors said. “[Changes were made] in standard operating procedures (SOPs) in some fleets, [and] stabilized approach and sterile cockpit policies in the operations manual. Considering the first LOSA results, related memos were sent to pilots of each fleet. Finally, useful changes were made in initial and recurrent training course syllabi, especially crew resource management and human factors.”

The changes generated as a result of the first LOSA paid off in the results of the second LOSA (Table 6). Errors were categorized into technical and non-technical types, with subcategories of each. In every subcategory, the second LOSA showed improvement.

“The most frequent type of technical errors [was] SOP cross-verification, followed by briefing,” the authors said. “The most frequent type of non-technical error [was] crew-to-crew communication.”

Notes

1. Khoshkhoo, R.; Goodarzi, F.; Sharafbafi, F. “Evaluation and Enhancing of Operational Performance and Training Objective in Accordance with Line Operations Safety Audit (LOSA).” *Proceedings of the 64th annual International Air Safety Seminar*. Flight Safety Foundation, November 2011.