2019

Loss of Control In-Flight Accident Analysis Report

Edition 2019

Guidance Material and Best Practices

IATA

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Loss of Control In-Flight Accident Analysis Report, 2019 edition
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Executive Summary

Loss of Control – Inflight (LOC-I) is the most significant cause of fatal accidents in commercial aviation. LOC-I occurs when an aircraft deviates from the intended flight path or an adverse flight condition places an aircraft outside the normal flight envelope, with the pilot unable to maintain control of the aircraft. A study of LOC-I accidents has been conducted to provide an overview of the subject.

A search was conducted of the IATA Global Aviation Data Management (GADM) accident database to identify accidents that were classified as LOC-I. The study focused on worldwide commercial jet and turboprop aircraft over the last 10 years (2009 through 2018) and found that:

- There were 64 LOC-I accidents identified over the 10-year reporting period.
- 94% of LOC-I accidents involved fatalities to passengers and/or flight crew.
- LOC-I resulted in more fatalities than any other accident category (2,462 of 4,075). It surpassed Controlled flight into Terrain (CFIT), Runway Excursions as the leading cause of fatalities in commercial aviation accidents.
- LOC-I accidents ranked the second highest in terms of hull losses after Runway Excursion accidents.
- LOC-I is one of the accident categories with the lowest survivability ratio.
- The LOC-I all accident and LOC-I fatal accident rates over the 10-year period are 0.17 and 0.16 per million sectors, respectively.
- LOC-I could occur during any phase of flight, but it is most common during Initial Climb (ICL).
- IATA Operational Safety Audit (IOSA)-registered airlines have a lower LOC-I accident rate than non-IOSA-registered airlines.
- LOC-I accidents happen more often on Generation Two turboprops operated by non-IOSA-registered carriers.
- LOC-I is a complex accident category in that the accidents can result from numerous contributing factors, either acting individually or (more often) in combination. Very often, the trigger that initiates a LOC-I accident sequence is an external environmental factor, predominantly meteorological.
- LOC-I accidents do not occur because of an inability to fly the aircraft manually but are rather due to a late or non-decision to take over control manually.
- The following factors which frequently constitute the LOC-I and may preclude an effective recovery are:
    - Human performance deficiencies
    - Automation and flight mode confusion
    - Distraction
    - Startle effect
    - Loss of situational awareness

LOC-I accidents often result from failure to prevent or recover from a stall and/or an upset. Pilots should not only be able to avoid stall and/or upset but should also be able to recover from such situation should they occur. Pilots can prevent and overcome LOC-I accidents through but not limited to:

- Increased awareness of the precursors leading to an upset or a stall
- Development of skills to recognize an upset early in its development
- Taking definitive action to recover from an upset
- Increased awareness for flight crews on the phases of flight and conditions where they are most vulnerable to a LOC-I
- Enhancing monitoring of aircraft and of flight path
- Increased awareness of the flight phases where poor monitoring can be most problematic
- Strategically plan workload to maximize monitoring during those areas of vulnerability (AOV)
- Briefing emphasis on pre-flight and in certain phases/impending night or IMC entries that complicate SA and recovery
- Increased awareness and understanding of certain controls and displays, such as the Flight modes annunciator (FMA) on the primary flight display (PFD)/ Electronic attitude director indicator (EADI)
- Develop a predictive cognitive picture (ahead of the aircraft) and predict on what the aircraft should be doing at certain points
- Constant awareness of stall margin throughout all phases of flight

Proper and adequate training with an emphasis on awareness and prevention provides pilots with the skills to recognize conditions that could lead to a LOC-I event, if not effectively managed.

Moreover, LOC-I is often linked to operation of an aircraft below stall speed. Even with fully protected aircraft, stall awareness, prevention and recovery training, as well as approach-to-stall recovery training, need to be addressed on a regular basis. Training must also be inclusive of the Crew Resource Management (CRM) techniques for the most effective threat prevention and mitigation strategies. The CRM training should focus on situation awareness, communication skills, monitoring, teamwork, task allocation, decision-making and error management within a comprehensive context of standard operating procedures (SOPs).

With LOC-I accidents resulting in more fatalities in commercial operations than any other accident category over the last decade, reducing LOC-I accidents is a priority for IATA and the aviation industry across the globe.

Section 1—Introduction

The International Air Transport Association (IATA) is dedicated to implementing a data-driven approach to the evaluation of aviation safety risks and the development of potential solutions. This analysis evaluates the contributing factors from recent LOC-I accidents and presents information designed to aid the industry in the implementation of mitigation strategies.

LOC-I refers to accidents in which the flight crew was unable to maintain control of the aircraft in flight, resulting in an unrecoverable deviation from the intended flight path. LOC-I can result from factors affecting piloting performance, engine failures, adverse meteorological conditions, stalls/upsets or other circumstances that interfere with the ability of the pilot to control the flight path of the aircraft. It is one of the most complex accident categories, involving numerous contributing factors that act individually or, more often, in combination. These contributing factors include latent conditions in the system, external threats to the flight crew, errors in the handling of those threats, and undesired aircraft states resulting from deficiencies in managing threats and errors. Contributing factors related to accidents presented in this report are based on the information available at the time of classification.

LOC-I accidents are almost always catastrophic; 94% of the accidents analyzed involved fatalities to passengers or flight crew. This category of accident resulted in more fatalities than any other category (2,462 of 4,075) in the reporting period (2009 through 2018). Given this severity, LOC-I accidents have been assessed by IATA and industry representatives as one of the highest priorities for safety intervention and risk mitigation.

This report is organized to provide dynamic and interactive data from 64 LOC-I accidents that occurred over the 10 years spanning from 2009 through 2018. This report is written to support a user-friendly methodology to analyze and visualize LOC-I accident data and to identify patterns, trends and comparisons between data selections.

Section 2—Loss of Control — Inflight Definition

The definition of LOC-I, as stated in the IATA Safety Report, is loss of aircraft control while in flight.

Section 3—Data Source

The data set from which this report was generated includes worldwide reported accidents resulting in a hull loss or substantial damage to aircraft with a certificated Maximum Takeoff Weight (MTOW) of at least 5,700 kg (12,540 lbs). These accidents occurred from January 2009 to December 2018, inclusively. The data were extracted from the IATA GADM Accident Database.

Section 4—Exclusions

This report excludes accidents involving the following types of operations:

- Private (general) aviation
- Business or military aviation
- Flights as part of illegal activities
- Humanitarian relief flights
- Crop spraying or other agricultural flights
- Security-related events (e.g., hijackings)
- Experimental or other test flights[1]
- Training flights include "Base Training" i.e flights without passengers on board, or non-revenue flights.

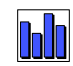
[1] Such as post-maintenance functional check flights

Section 5—Scope

The purpose of this report is to share information on LOC-I accidents and to determine how and why they happened. It is intended to identify contributory factors that may have led to such events and from which preventive measures can be formulated. Furthermore, it contains recommendations to assist in the reduction of LOC-I accidents.

Section 6—Manipulating the Interactive Report

Interactive reporting enables the reader to customize reports. If you see an Excel icon, such as the one shown in this section, it means the chart is interactive.



To run an interactive chart, follow these steps:

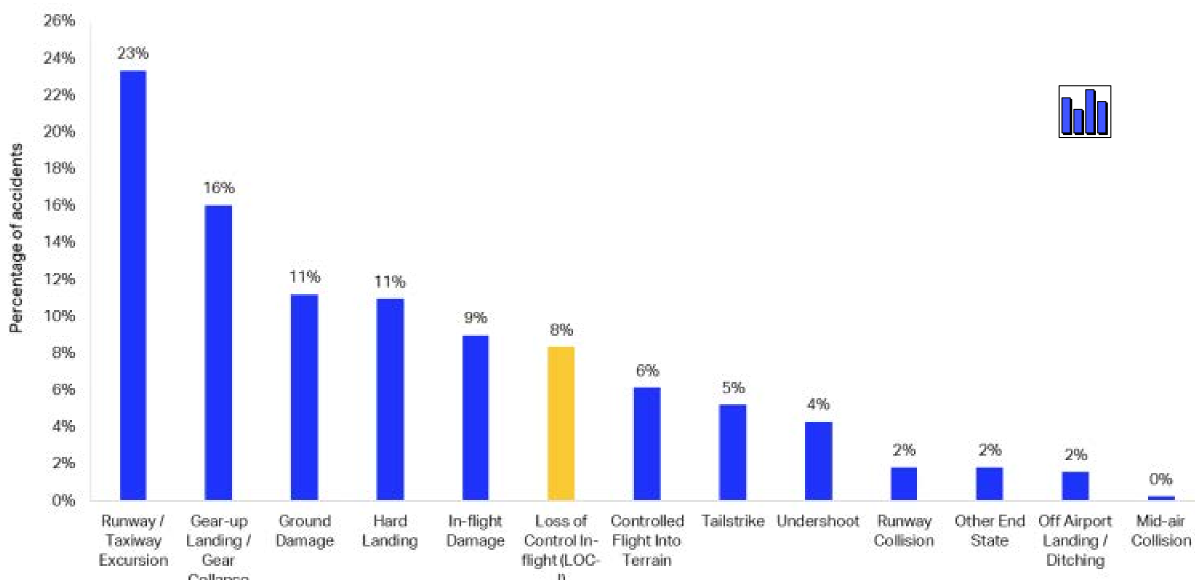
- Double-click on the graph icon at the top right-hand corner of the chart.
- Click Enable Macros, if asked.
- Select the desired conditions in the filter box next to the chart.
- Select the range of years at top of the chart.

This report allows you to focus more precisely on certain data by applying a combination of filters. Click and highlight your selection, and the data will automatically correspond to your choice. While each chart is presented in the best way for its data, you may select the options you like in any way you would like them displayed.

Section 7—A Comparison of LOC-I Accidents Relative to Other Accident Categories

A total of 777 commercial aviation accidents were recorded in the IATA GADM Accident Database; about 8%, or 64, of which were classified by the Accident Classification Technical Group (ACTG) as LOC-I. Figure 1 illustrates the global breakdown of accidents across all accident categories. It should be noted that, in 767 of the accidents, enough information was available for the ACTG to determine the accident category (End State[2]), while the remaining ten accidents lacked sufficient information.

LOC-I ACCIDENTS ACCOUNT FOR ALMOST 8% OF TOTAL ACCIDENTS



Source: IATA GADM

Figure 1. Percentage of Commercial Accident Categories in Relation to Total Accidents

Out of the 777 accidents, 135 were fatal, resulting in 4,075 fatalities. LOC-I was the most frequent category of fatal accidents, representing 60 fatal accidents or about 44% of fatal accidents. These LOC-I accidents resulted in 2,462 fatalities among passengers and crew. LOC-I is one of the accident categories with the lowest survivability ratio. Data for the top six fatal accident categories, as reported in the last 10 years, are shown in Figure 2.

[2] An End State is the first unrecoverable stage of an accident, also known as the Accident Category.

LOC-I IS THE NUMBER ONE FATAL ACCIDENT CATEGORY

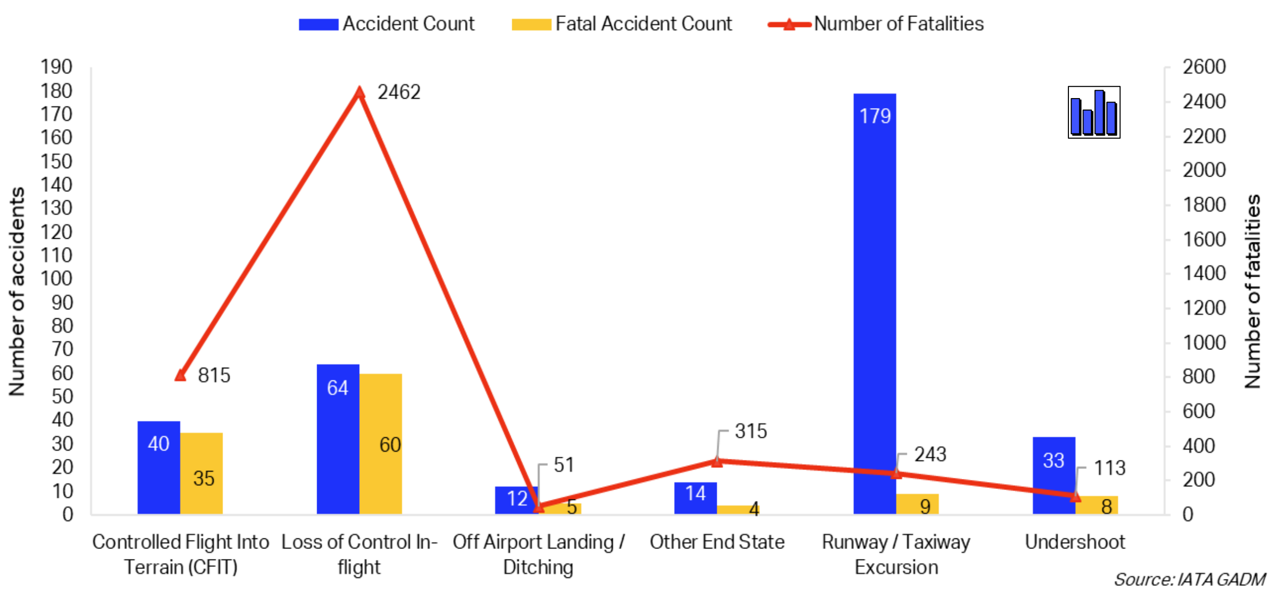


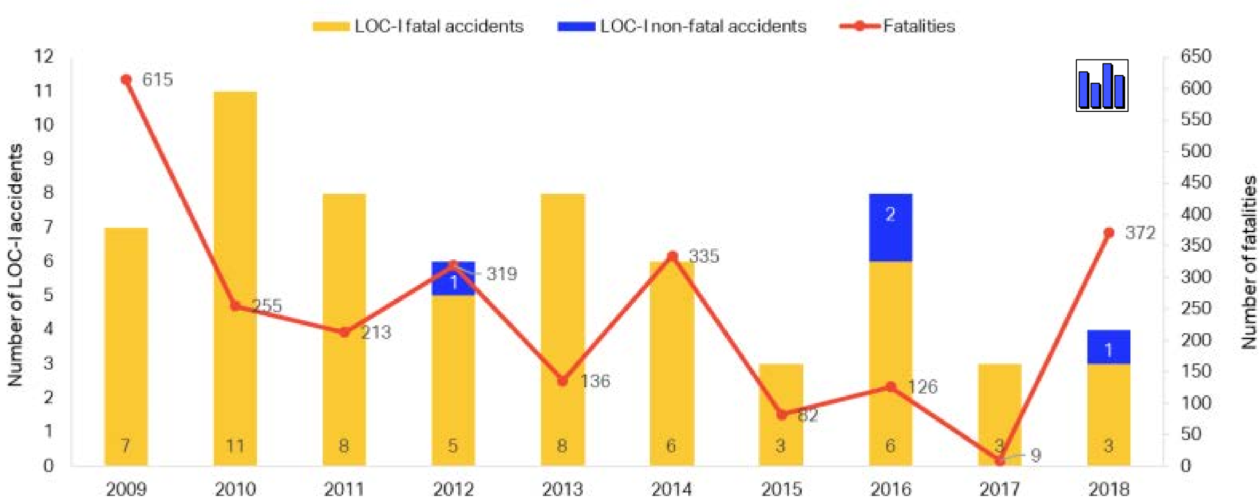
Figure 2. Data on the Top Six Fatal Accident Categories

Despite the fact that LOC-I accidents represented only about 8% of all commercial aircraft accidents under review, this risk area was the highest fatal accident category. As a result, this issue deserves industry attention.

Section 8—LOC-I Accident Data

Over the 10-year period, a total of 64 LOC-I accidents were reported to IATA GADM accident database, with an average of about almost seven accidents per year. Still, the worldwide number of yearly LOC-I accidents and deaths have been trending downwards. Figure 3 illustrates the annual distribution of LOC-I fatal and non-fatal accidents, and the number of fatalities associated with this accident category. The data shows that the number of fatalities (82) recorded in 2015 fell sharply from 2014 (335). The number of fatalities (126) recorded in 2016 was higher than in 2015. However, the number of fatalities (9) in 2017 was marked the lowest in a decade. The three LOC-I accidents in 2018 resulted in 372 fatalities. LOC-I accidents in 2018 accounted for 8% of all accidents, but resulted in 60% of onboard fatalities. As such, LOC-I has retained its status of having a high fatality risk.

DUE TO THE HIGH NUMBER OF FATALITIES ASSOCIATED WITH THIS ACCIDENT CATEGORY IN 2018, LOC-I HAS THE HIGHESTFATALITY RISK



Source: IATA GADM

Figure 3. Data on the Top Six Fatal Accident Categories

When comparing LOC-I data over the five-year periods from 2009-2013 and 2014-2018, it is apparent that there is an improvement in this accident category. There were fewer LOC-I accidents over the last five years when compared with earlier years. From 2009-2013, there were 40 LOC-I accidents, 39 of which were fatal, resulting in 1,538 deaths versus 24 accidents from 2014-2018, 21 of which were fatal, resulting in 924 fatalities.

There were 372 fatalities in 2018; the steep rise from 9 fatalities in 2017 was attributed to three very high-profile aircraft fatal accidents in 2018:

1. Crashed into the Java Sea in October and resulted in 189 deaths.
2. Crashed shortly after takeoff in May, killing 112 people on board.
3. Crashed shortly after takeoff in February, killing 71 passengers and flight crew.

Absolute numbers of accidents are seldom a good indication of safety performance and are of limited comparative value unless they are normalized by the number of sectors[3] flown per year to create an accident rate. Figure 4 presents the LOC-I accident rates by year.

THE LOC-I FATAL AND NON-FATAL ACCIDENT RATES HAVE BEEN TRENDING DOWWARDS

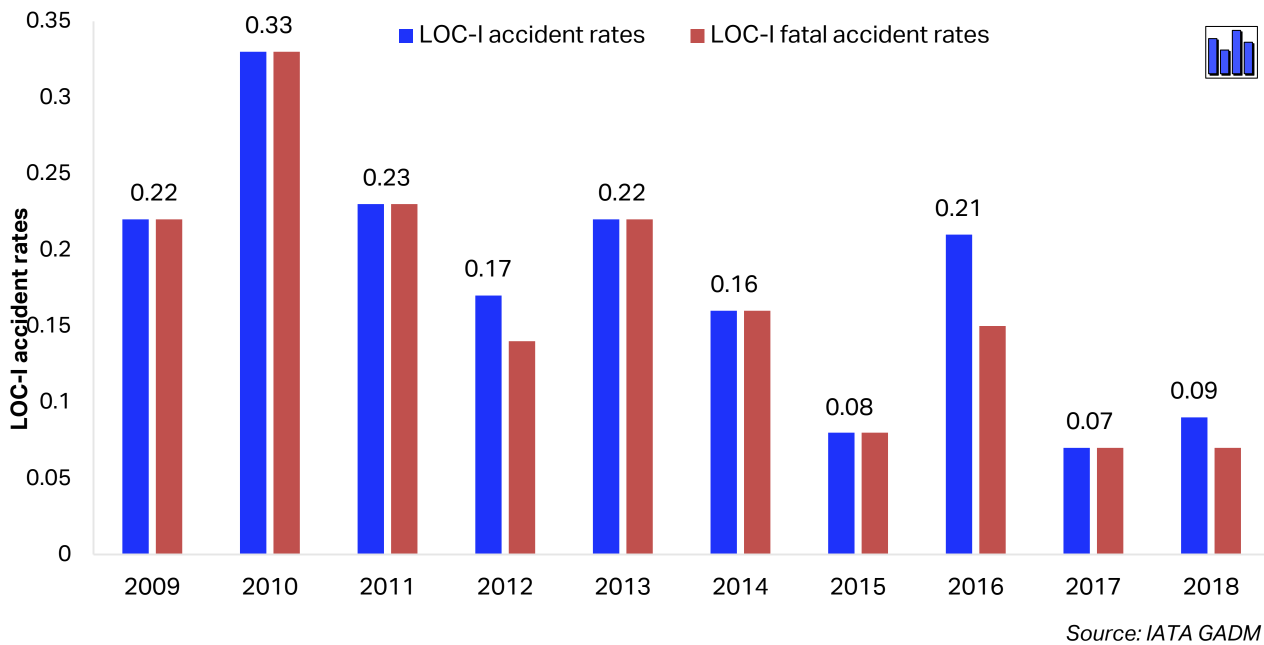


Figure 4. Distribution of LOC-I Accident Rates (Fatal Vs All LOC-I accidents) Per Year

Note: Where the accident rates are equal, this indicates that all LOC-I accidents that year were fatal.

The data also shows that the average LOC-I accident rate over the two five-year periods has been improving; the five-year average of LOC-I all accident rates and LOC-I fatal accident rates (from 2009 through 2013) was 0.23 compared to the 2014-2018 five-year average of LOC-I all accident rates and LOC-I fatal accident rated 0.12 and 0.11 accidents per million sectors. Full years 2017 and 2018 were below the most recent five-year average.

[3] IATA defines "sector" as the aircraft between takeoff at one location and landing at another location (other than a diversion).

8.1 LOC-I Accidents by Flight Phase

LOC-I accidents have the potential to occur during any airborne flight, but LOC-I was most common during Initial Climb (ICL)[4], as seen in Figure 5. The 17 fatal and non-fatal LOC-I accidents on ICL are above the average of almost seven accidents per year. Takeoff (TOF) and ICL make up 39% of the total LOC-I accidents. LOC-I accidents at TOF and ICL are often the result of, or a combination of, the following factors:

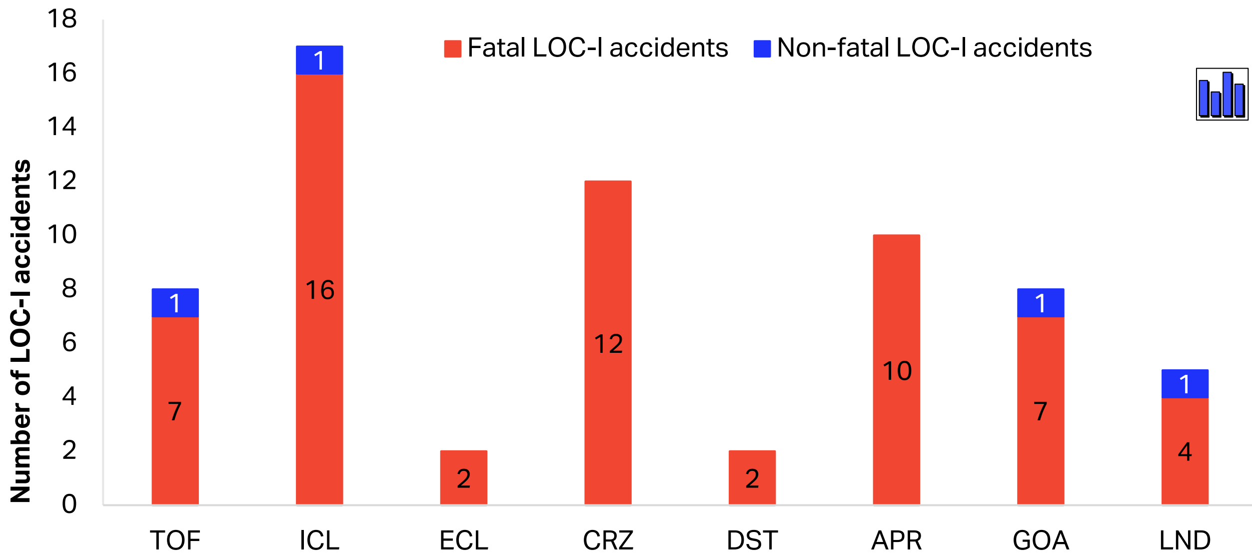
- Aircraft system malfunction
- Operating outside aircraft limitation
- Poor manual handling
- Poor, or lack of decision-making
- Inadequate crew monitoring and cross checking
- Operating in adverse weather conditions
- Non-adherence to Standard Operating Procedures (SOPs)
- Inadequate classroom and simulator training

One of the best defenses against LOC-I is pilot awareness. Cockpit decision making, and task prioritization are also essential. Pilots need to focus on flying the aircraft at all times. This is also true in low altitude, because low flying especially in adverse weather conditions can cause misjudgment of the environment leading to wrong decision making. Pilots must stay ahead of their aircraft and are recommended to always monitor the instruments, manage distractions, know the aircraft limitations and thresholds for critical Angle of Attack (AOA), and make changes in power or pitch as required to prevent LOC-I before they happen. In some cases, a safe recovery may not be possible if LOC-I occurs at low altitude; prevention is always essential.

Effective monitoring the aircraft's flight path and aircraft systems, as well as actively cross-checking each other's action during the critical phases of flight can be the last line of defense. If this layer of defense is not present, an error may go undetected, leading to an adverse safety consequences or unwanted situation. By enhancing monitoring and cross-checking, a pilot will be more likely to catch an error before it occurs. It is essential that pilots are trained to recognize the flight phases where poor monitoring can be most problematic. Pilots should strategically plan their workload to maximize monitoring during those areas of vulnerability (AOV).

[4] The list of phases of flight and their acronyms can be found in Appendix A.

THE HIGHEST FREQUENCY OF ACCIDENTS OCCURRED DURING INITIAL CLIMB (ICL)



Source: IATA GADM

Figure 5. Distribution of LOC-I Accidents by Phase of Flight

8.2 LOC-I Accidents by Aircraft Propulsion Type

This section provides a breakdown of LOC-I accidents by type of aircraft propulsion. Commercial jet aircraft were involved in 27 accidents, or 42% of all LOC-I accidents; while turboprop operations, which accounted for a small portion of all sectors flown, were involved in 37 accidents, or 58% of total LOC-I accidents. Figure 6 illustrates the distribution of LOC-I accidents by aircraft propulsion type per year. The data shows that there were zero jet LOC-I accidents in 2015 and 2017, but four jet accidents in 2018. The four jet LOC-I accidents in 2018 were above the average of three accidents per year for jet LOC-I accidents over the ten-year study period. Whereas, turboprop aircraft had zero accidents in 2018.

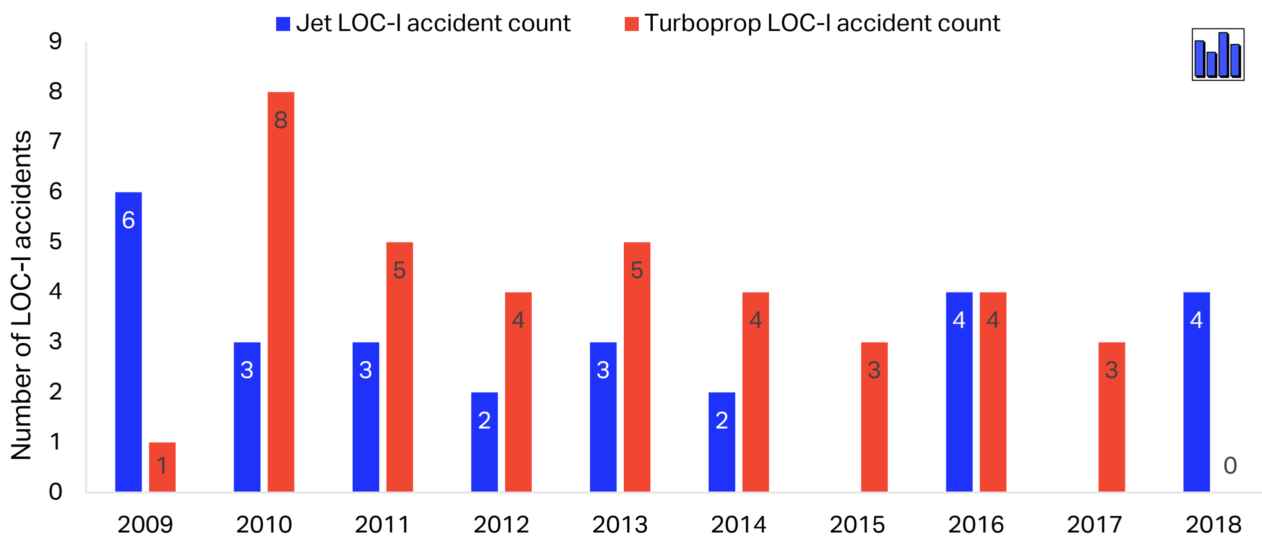
22% of jet aircraft LOC-I accidents happened during Cruise and were all fatal. Whereas, 35% of turboprop LOC-I accidents occurred during ICL and only one of those accidents occurred with no fatalities.

Failure to recognize deteriorating weather continues to be a contributing factor in both jet and turboprop LOC-I accidents. Jet and turboprop accidents are also more likely to occur when there is a/an:

- Aircraft System malfunction
- Loss of engine power before losing control in Instrument Meteorological Condition (IMC)
- Vertical/Lateral/speed deviation
- Icing Conditions
- Operation outside of the aircraft limitation

More information on factors contributing to LOC-I accidents can be found in Section 8.9.

JET AIRCRAFT WERE INVOLVED IN 42% OF LOC-I ACCIDENTS AND TURBOPROP AIRCRAFT WERE INVOLVED IN 58% OF TOTAL LOC-I ACCIDENTS



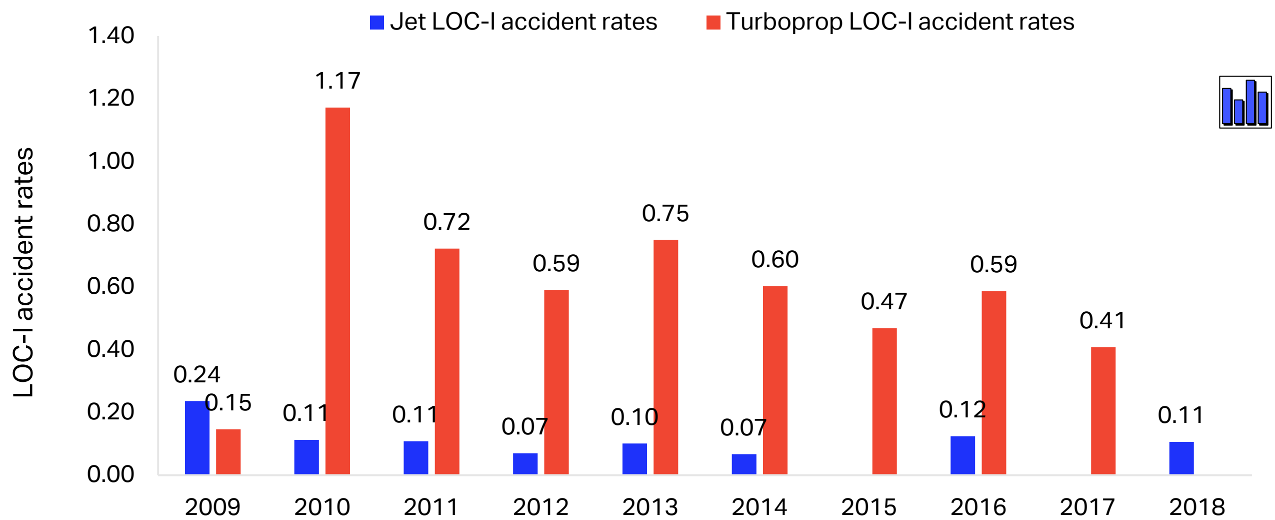
Source: IATA GADM

Figure 6. Distribution of Jet and Turboprop Aircraft LOC-I Accidents

When converting jet and turboprop accident frequencies to accident rates per million sectors, it was found that turboprop aircraft had a significantly higher average rate of LOC-I accidents than jet aircraft (0.55 accidents per million flights for turboprops as opposed to 0.09 for jets). Figure 7 illustrates the distribution of accident rates per year broken down by aircraft propulsion type.

The turboprop LOC-I accident rate was much higher than the jet accident rate per million sectors, which is consistent with the all-accident rate. Turboprop aircraft operated almost 19% of the world's commercial flights during the reported period from 2009 through 2018. An improvement in turboprop safety can be seen in the 2018 LOC-I all-accident turboprop rate, which shows a 0.00 per million flights (zero accidents).

THE TURBOPROP LOC-I ACCIDENT RATE IS HIGHER THAN THE JET LOC-I ACCIDENT RATE



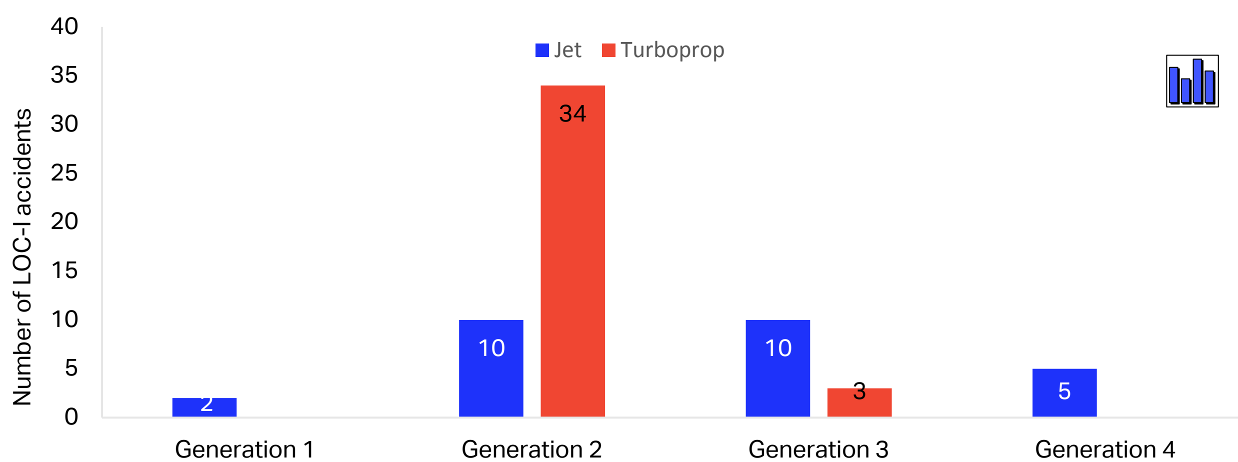
Source: IATA GADM

Figure 7. Distribution of Jet and Turboprop LOC-I Accident Rates

8.3 LOC-I Accidents by Aircraft Generation

Comparison of LOC-I accidents by aircraft generation shows that LOC-I accidents happen more often on Generation Two aircraft during the 2009-2018 study period. Further analysis and normalization of this data is required before any firm conclusion can be drawn from this fact. Figure 8 illustrates the distribution of LOC-I accidents per aircraft generation. The divisions of the aircraft generation are largely based on the representation of the aircraft generation considered in the data report of the Evidence Based Training (EBT), and on the year the aircraft was introduced.

THE LARGEST NUMBER OF LOC-I ACCIDENTS OCCURRED ON GENERATION TWO AIRCRAFT



Source: IATA GADM

Figure 8. LOC-I Accidents by Aircraft Generation

8.4 LOC-I Accident Severity

LOC-I accidents are severe in terms of the number of fatalities and extent of damage to the airframe. Only two out of the 64 accidents during the 10-year study period did not result in a hull loss (yet sustained substantial damage) and a total of four accidents reported no fatalities.

Figure 9 illustrates the distribution of LOC-I fatal hull loss, non-fatal substantial damage and non-fatal hull loss accidents.

THE VAST MAJORITY OF LOC-I ACCIDENTS RESULTED IN FATAL HULL LOSS ACCIDENTS

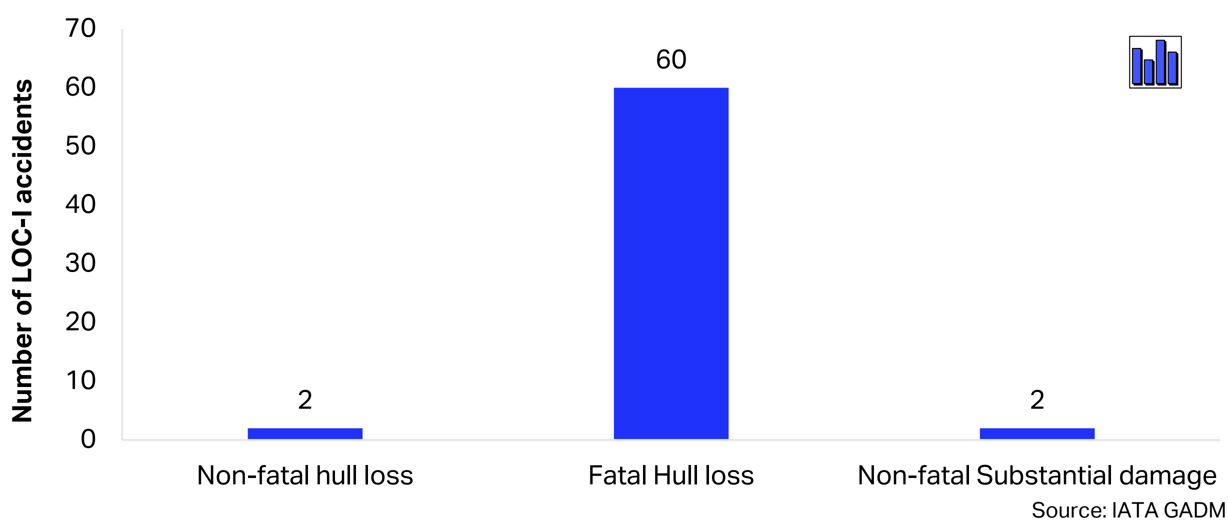


Figure 9. Distribution of LOC-I Fatal Hull Loss, Non-Fatal Substantial Damage and Non-Fatal Hull Loss Accidents

The data analysis shows that LOC-I accidents ranked the second highest in terms of hull losses after Runway Excursion accidents. Nevertheless, there has been recent industry emphasis on fatalities being a more accurate representation of accident severity as opposed to hull losses.

LOC-I was the biggest single cause of commercial transport aircraft fatal accidents. Figure 10 illustrates the annual distribution of the 60 fatal LOC-I accidents from 2009 through 2018. Although the number of LOC-I fatal accidents has been fluctuating, the average of LOC-I fatal accidents has improved from a yearly average of eight LOC-I fatal accidents for the five years from 2009 through 2013 to four fatal accidents per year from 2014 through 2018.

THE AVERAGE NUMBER OF LOC-I FATAL ACCIDENTS PER YEAR HAS IMPROVED

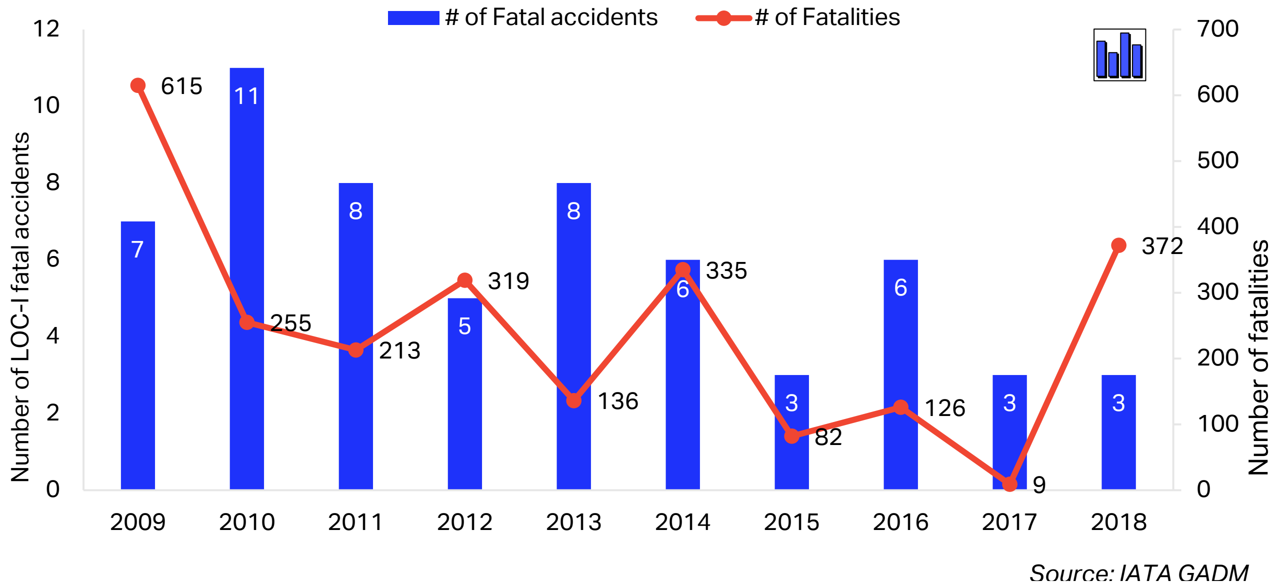


Figure 10. Annual Distribution of Fatal LOC-I Accidents

Although turboprop aircraft had a higher number of LOC-I fatal accidents, jet aircraft had a higher number of fatalities (1,882 vs. 580 for turboprop); this reflects the capacity difference of jet versus turboprop aircraft. Table 1 presents the number of LOC-I fatal accidents, normalized as rates per million sectors, and the number of fatalities per aircraft propulsion type.

Table 1. LOC-I Accident Data and Number of Fatalities by Aircraft Propulsion Type

Year	Number of jet non-fatal accidents	Number of jet fatal accidents	Jet fatal accident rate	Number of fatalities on jets	Number of turboprop non-fatal accidents	Number of turboprop fatal accidents	Turboprop fatal accident rate	Number of fatalities on turboprops
2009		6	0.24	566		1	0.72	49
2010		3	0.11	103		8	0.44	152
2011		3	0.11	154		5	0.75	59
2012		2	0.07	280	1	3	0.44	39
2013		3	0.10	60		5	0.75	76
2014		2	0.07	278		4	0.60	57
2015		0	0.00	0		3	0.47	82
2016	1	3	0.09	69	1	3	0.44	57
2017		0	0.00	0		3	0.41	9
2018	1	3	0.08	372		0	0.00	0

Over the report period, IATA member airlines had a lower accident rate than non-IATA members (0.06 vs 0.28). IATA member airlines also had a lower accident rate compared to the industry average. The accident rate for IATA carriers is at the lowest level since IOSA became a condition of IATA membership.

8.5 LOC-I Accident Rates for IOSA-Registered Carriers versus Non-IOSA-Registered Carriers

The IOSA program is an internationally recognized and accepted evaluation system designed to assess the operational management and control systems of an airline. All IATA members are IOSA-registered and must remain registered to maintain IATA membership. As at 14 May 2019, there are currently 430 airlines on the IOSA registry of which 138 are non-IATA members.

The positive results of IOSA are also illustrated when all accidents are broken down to show the rate for IOSA-registered airlines compared to the rate for operators not on the IOSA registry. The overall average LOC-I accident rate for IOSA-registered airlines was 8.4 times lower than that for non-IOSA-registered airlines for the period between 2009 and 2018 (0.05 vs. 0.42). Figure 11 illustrates the LOC-I accident rates for IOSA-registered carriers versus non-IOSA-registered carriers.

IOSA-REGISTERED AIRLINES HAVE A LOWER LOC-I ACCIDENT RATE THAN NON-IOSA- REGISTERED AIRLINES

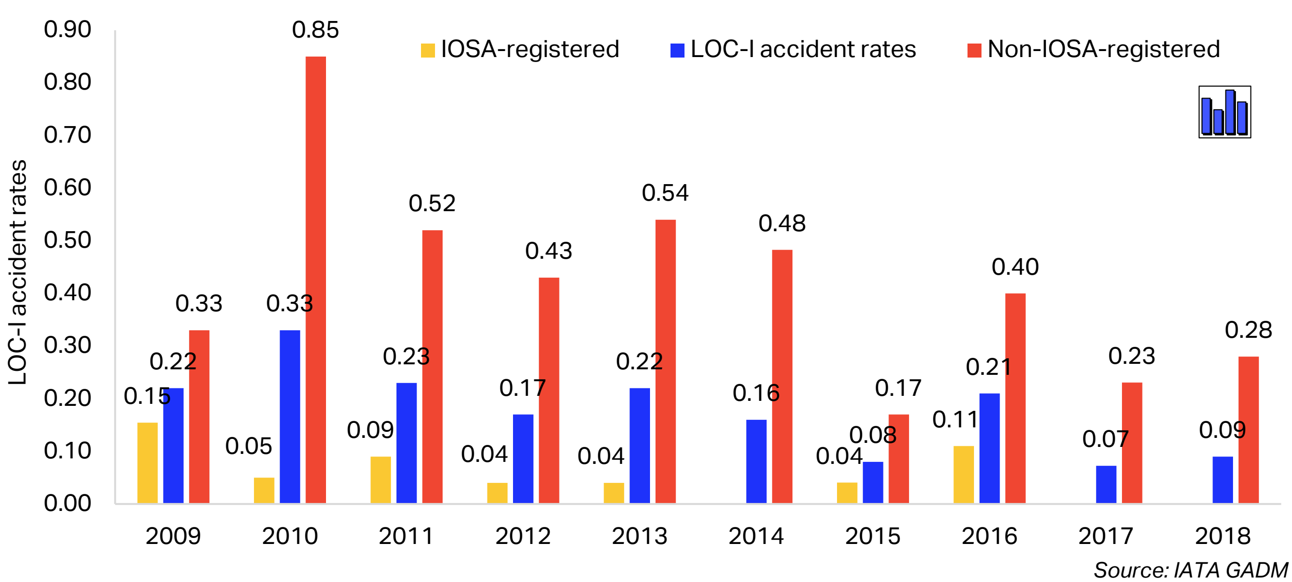


Figure 11. LOC-I Accident Rates for IOSA Versus Non-IOSA-Registered Carriers

Comparing aircraft propulsion types in terms of IOSA and non-IOSA-registered carriers, as shown in Table 2, it is notable that 52% of the jet accidents were non-IOSA carriers and 86% of the turboprop accidents were non-IOSA airlines.

Table 2. LOC-I Accidents by Aircraft Propulsion Type and IOSA Vs. Non-IOSA (2009–2018)

Service	IOSA	Non-IOSA
Jet	13	14
Turboprop	5	32

This analysis shows that operators continue to deliver better safety performance when the operator's operational infrastructure, including that of its safety management capabilities, is robust. Furthermore, operational standards such as IOSA are a key to safer operations.

8.6 LOC-I Accidents by Type of Service

Different operational service types and/or the familiarity of the operating environment can influence the potential for a LOC-I accident. This section presents the impact of different types of operational service (i.e., cargo vs. passenger operations and scheduled vs. unscheduled operations). From 2009 through 2018, 43 accidents, or 66% of total LOC-I accidents, involved passenger flights; and, 21 accidents, or 32%, were represented by cargo operations. One accident, or 2%, involved a ferry flight. Table 3 presents the breakdown of LOC-I accidents by the type of service and operation.

Note: Since we do not have the sector information to normalize the data in this section, it is very difficult to draw any firm conclusions.

Table 3. LOC-I Accidents by Type of Service and Operation

Service	Total LOC-I accidents	Domestic flights	International flights
Passenger	43	30	13
Cargo	20	13	7
Ferry	1	0	0

Analyzing the type of service and operation involved in LOC-I accidents by operator region, as presented in Table 4, it is notable that Asia Pacific (ASPAC), Latin America and Caribbean (LATAM/CAM), and Commonwealth of Independent State (CIS) had the highest number of LOC-I passenger accidents in domestic flights, whereas Africa (AFI) and North America (NAM) had the highest number of LOC-I Cargo accidents. More Regional LOC-I accident analysis can be found in Section 8.8.

Table 4. Type of Service and Operation Involved In LOC-I Accidents by Operator Region

	LOC-I passenger accidents		LOC-I cargo accidents	
Region	Domestic Flights	International Flights	Domestic Flights	International Flights
AFI	4	1	4	2
ASPAC	7	2	1	0
CIS	6	1	2	1
EUR	0	5	1	0
LATAM	7	0	2	1
MENA	2	4	0	1
NAM	3	0	3	2
NASIA	1	0	0	0

Moreover, when LOC-I accidents were broken down by scheduled and non-scheduled operations, it is apparent that scheduled passenger operations had a higher number of accidents (almost by a factor of 6) compared to non-scheduled passenger operations, while it was reversed with cargo operations. The data shows that all cargo LOC-I accidents (scheduled and non-scheduled) were fatal. Table 5 summarizes the number of accidents by scheduled vs. non-scheduled operations.

Note: Scheduled transportation accounts for most of passenger fights, and this factor of 6 is only about numbers and not rates.

Table 5. LOC-I Accidents By Scheduled Vs. Non-Scheduled Operations

	All	Fatal	Fatalities	Survivability
Passenger				
Scheduled	37	34	2,226	24%
Non-Scheduled	6	5	117	37%
Cargo				
Scheduled	7	7	22	8%
Non-Scheduled	13	13	94	8%
Ferry				
Ferry	1	1	3	0

The following section presents an analysis of the regional differences in LOC-I accidents. Regions are defined by IATA and the breakdown of regions by country is listed in Appendix B.

8.7 LOC-I Regional Analysis

A comparison of all LOC-I accidents versus fatal accidents with respect to each of the IATA regions of operation shows that all LOC-I accidents involving operators from AFI, CIS, NAM and North Asia (NASIA) were fatal accidents. Figure 12 presents the overall distribution of LOC-I accidents by IATA region of operation for the reporting period 2009 through 2018.

The four regions of operation that marked equal or below the total global regional average of eight accidents per region were Europe (EUR), NASIA, Middle East and North Africa (MENA), and NAM. The other regions were above the total global regional average for fatal and non-fatal LOC-I accidents.

50% OF THE REGIONS MARKED EQUAL OR BELOW THE ANNUAL GLOBAL REGIONAL AVERAGE OF EIGHT LOC-I FATAL AND NON-FATAL ACCIDENTS

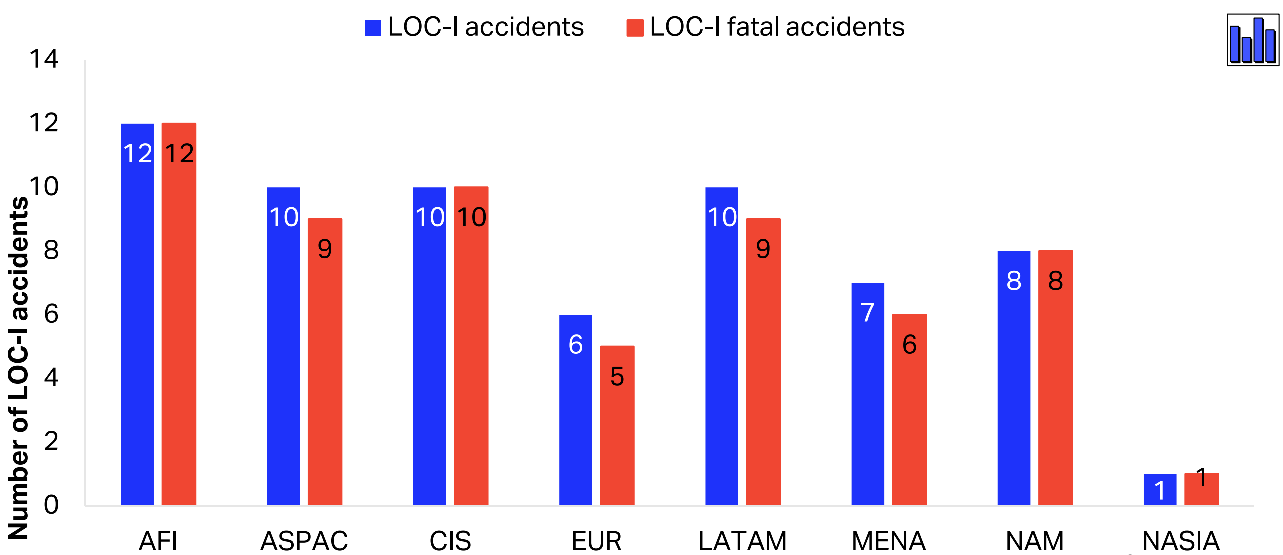


Figure 12. LOC-I Accidents by Region of Operator

The same data is normalized to reflect the regional accident rates per million sectors. It indicates that the highest accident rates were found for AFI and CIS operators, with rates of 0.96 and 0.81 accidents per million sectors flown, respectively. Figure 13 presents the all-LOC-I and fatal accident rates per million sectors based on the region of registration of the operator. It is worth noting that the following regions outperformed the global LOC-I accident rate of 0.36 and LOC-I fatal accident rate of 0.34: ASPAC, EUR, LATAM/CAR, NAM, and NASIA.

OPERATORS FROM AFI AND CIS HAD THE HIGHEST LOC-I ACCIDENT RATES

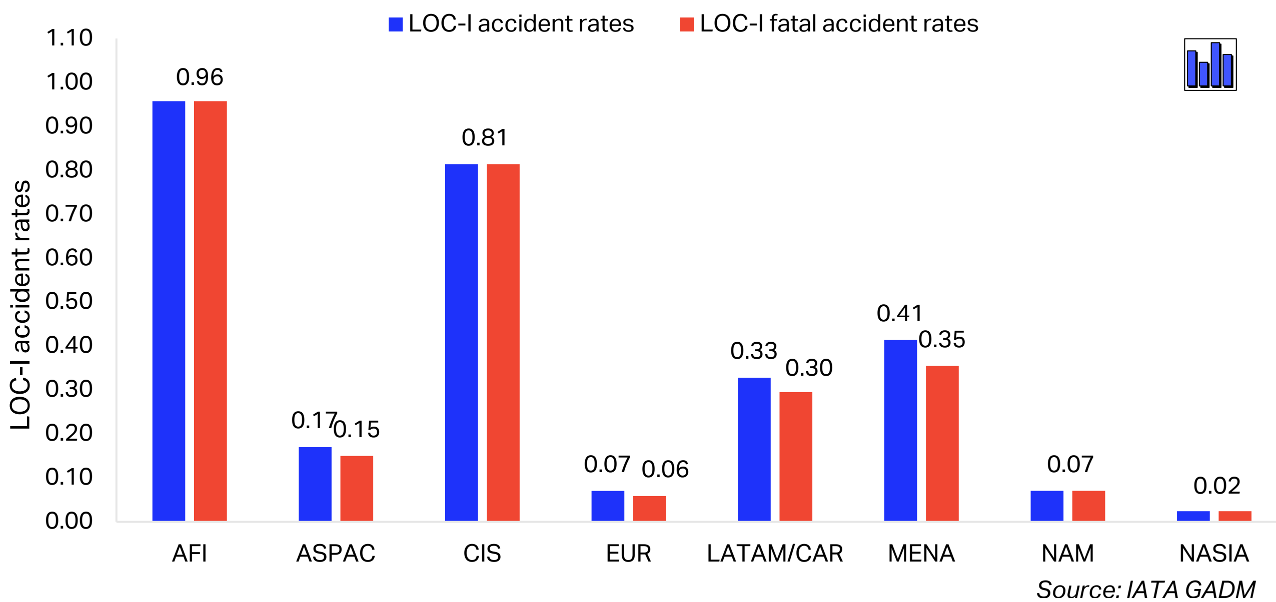
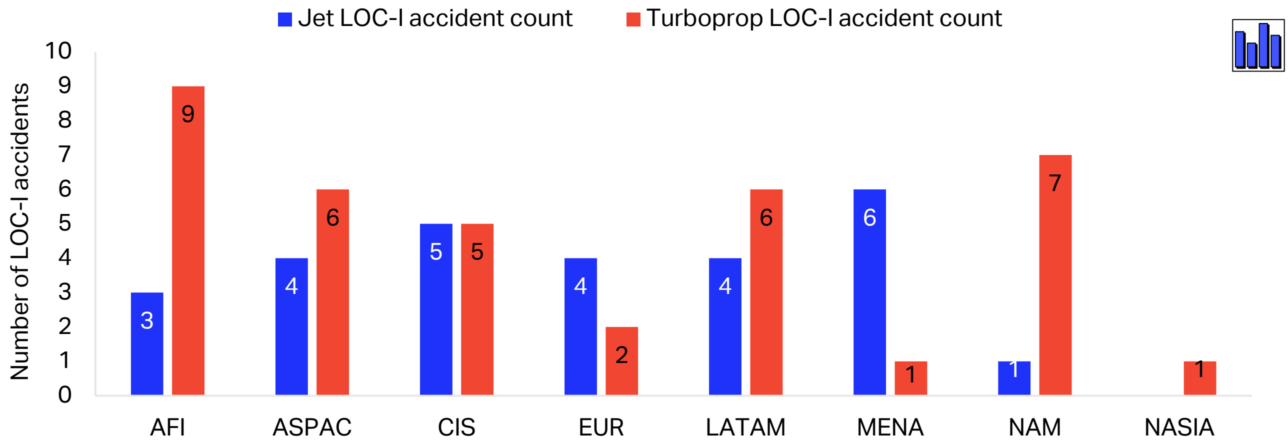


Figure 13. LOC-I Vs. Fatal Accident Rates by IATA Region of Operator

Note: Where the accident rate is equal, this indicates that all LOC-I accidents involving operators based in that region were fatal.

The number of LOC-I accidents involving turboprop aircraft versus jet aircraft by region of operator is presented in Figure 14. The data shows that NASIA operators had no jet LOC-I accidents. MENA and EUR had more jet LOC-I accident than turboprop accidents. CIS had an equal number of jet and turboprop accidents.

FIVE OUT OF EIGHT IATA REGIONS HAD A HIGHER NUMBER OF TURBOPROP LOC-I ACCIDENTS COMPARED TO JETS

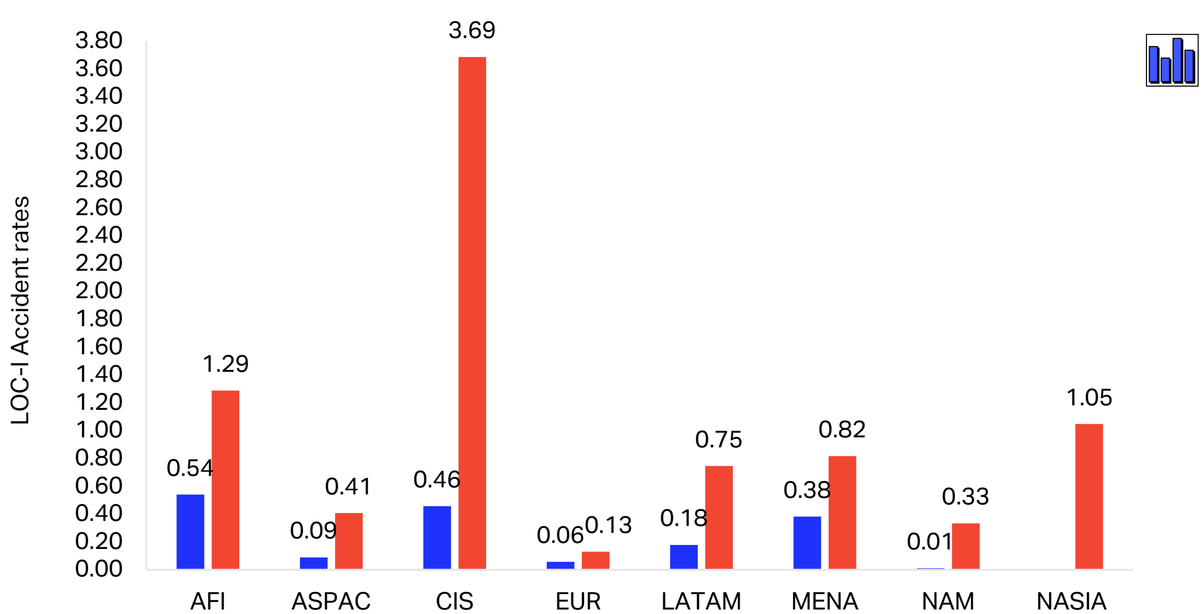


Source: IATA GADM

Figure 14. Distribution of Jet Versus Turboprop LOC-I Accident Frequency Per Region of Operator

Although AFI recorded the highest number of turboprop LOC-I accidents, when taking into account the number of turboprop sectors flown, CIS had the highest LOC-I accident rate. As seen in Figure 15, all regions had higher turboprop versus jet LOC-I accident rates. Three regions (AFI, CIS and MENA) marked higher jet LOC-I accident rates than the average of 0.21. Whereas, two regions (AFI and CIS) marked higher turboprop LOC-I accident rates than the average of 1.06.

AFI and CIS MARKED HIGHER THAN AVERAGE TURBOPOROP AND JET LOC-I ACCIDENT RATES



Source: IATA

Figure 15. Comparison of Turboprop Versus Jet Accident Rates by Region of Operators

The number of LOC-I accidents involving IOSA and non-IOSA turboprop aircraft versus jet aircraft by region of operator is presented in table 6. The data shows that African based operators had the highest turboprop non-IOSA LOC-I accidents whereas MENA had the highest IOSA jet LOC-I accidents.

Table 6. Regional Distribution of LOC-I Jet and Turboprop Accidents (IOSA Versus Non-IOSA)

	Jet Count	Turboprop Count	Jet Rate	Turboprop Rate
IOSA				
AFI	1	0	0.26	0.00
ASPAC	2	1	0.07	0.28
CIS	2	1	0.29	2.54
EUR	3	1	0.06	0.11
LATAM	0	0	0.00	0.00
MENA	5	0	0.39	0.16
NAM	0	1	0.00	1.85
NASIA	0	1	0.00	0.00
Non-IOSA				
AFI	2	9	1.15	1.63
ASPAC	2	5	0.12	0.45
CIS	3	4	0.73	4.15
EUR	1	1	0.05	0.17
LATAM	4	6	0.97	1.05
MENA	1	1	0.34	1.66
NAM	1	6	0.04	0.41
NASIA	0	0	0.00	0.00

It is recognized that LOC-I accidents are generally the consequence of a chain of events, and not the result of just one contributing factor. The next section details the common factors contributing to LOC-I accidents.

8.8 Contributing Factors to LOC-I Accidents

LOC-I accidents result from numerous contributing factors that may occur individually, but quite often occur in combination. LOC-I accidents are typically induced by aircraft system malfunctions, environmental threats and/or pilot errors.

This section provides further insight into the contributing factors that may have led to a LOC-I accident. The identification and analysis of common contributing factors for LOC-I accidents should be useful in establishing mitigation strategies.

IATA, through the ACTG, assigns contributing factors to accidents to better understand the correlations. The contributing factors, which follow a Threat and Error Management (TEM) structure, are divided into the following areas:

- **Latent Conditions:** Conditions present in the system before the accident and triggered by various possible factors.
- **Environmental and Airline Threats:** An event or error that occurs outside the influence of the flight crew, but which requires crew attention and management if safety margins are to be maintained.
- **Flight Crew Errors:** An observed flight crew deviation from organizational expectations or crew intentions.
- **Undesired Aircraft States:** A flight crew-induced aircraft state that clearly reduces safety margins; a safety-compromising situation that results from ineffective error management. An UAS is recoverable.

The most common contributing factors to LOC-I accidents are listed in Table 7.

Note: 9 LOC-I accidents (or 14%) were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Table 7. Most Frequent LOC-I Contributing Factors

Latent Conditions	Percentage	Flight Crew Errors	Percentage
Safety Management	**38%**	SOP Adherence / SOP Cross-verification	**42%**
Flight Operations	**36%**	Manual Handling / Flight Controls	**42%**
Regulatory Oversight	**31%**	Intentional	**22%**
Flight Ops: Training Systems	**27%**	Unintentional	**18%**
Flight Ops: SOPs & Checking	**22%**	Pilot-to-Pilot Communication	**18%**
Environmental Threats	**Percentage**	**Undesired Aircraft States**	**Percentage**
Meteorology	**44%**	Vertical / Lateral / Speed Deviation	**31%**
Lack of Visual Reference	**15%**	Operation Outside Aircraft Limitations	**31%**
Poor Visibility / IMC	**15%**	Unnecessary Weather Penetration	**16%**
Icing Conditions	**15%**	Unstable Approach	**13%**
Wind / Wind shear / Gusty wind	**15%**	Abrupt Aircraft Control	**11%**
Airline Threats	**Percentage**	**Countermeasures**	**Percentage**
Aircraft Malfunction	**44%**	Overall Crew Performance	**42%**
Contained Engine Failure / Powerplant Malfunction	**27%**	Monitor / Cross-check	**27%**
Maintenance Events	**11%**	Leadership	**20%**
Operational Pressure	**9%**	Captain should show leadership	**20%**
		Inflight decision-making / contingency management	**18%**

LOC-I accidents were prone to a number of contributing factors. These include:

- Deficiencies in the implementation of Safety Management Systems (SMS) at the operator level Inadequate training standards and inadequate classroom and simulator training.
- Non-compliance with SOPs
- Overall flight crew performance[5]
- Aircraft system malfunction
- Late or lack of decision-making
- Operating in adverse meteorological conditions
- Inadequate monitoring, cross-checking and leadership behavior
- Incorrect response to the scenario faced, which puts the aircraft in a position that is either at the limits of recoverable or beyond recovery
- Reluctance to disengage automation or to change the level of automation

A positive safety culture is a prerequisite for a successful and effective Safety Management System (SMS) implementation. Hence the development and maintenance of appropriately targeted comprehensive and operationally relevant human factors training programs, through a positive safety culture is essential as it can have a direct impact on the bottom line of organizational safety management. The data shows that inadequate SMS were cited in 38% of the LOC-I accidents. Fifty seven percent of those were operated on turboprop aircraft, it is therefore important for the turboprop aircraft operators and the industry as a whole to adhere to and ensure they are applying the principles of SMS, CRM principles and leadership "championing" as well as supporting a stringent safety culture. Leadership support of a positive safety culture is the foundation upon which safety management is built and minus this foundation SMS principles cannot be sustained.

One of the frequently cited factors for LOC-I is the lack/late decision by pilots to take over control manually and in some circumstances, they did not take over. Some accident investigation reports indicated inadequate flight control input by the pilots, or even late input after the situation had developed to an almost irretrievable point. Therefore, enhanced CRM behavior, timely inflight decision making, communication, and flight path monitoring should help mitigate LOC-I accidents. IATA has developed guidance material for Improving Flight Crew Monitoring, with the aim of providing practical guidance to operators wishing to enhance their training for developing monitoring skills for pilots in line operations. This document also reiterates that operator's policy should emphasize the cognitive resources needed to monitor and should state that monitoring must be adapted to the phase of flight. This implies highlighting the importance of situation awareness and workload management to support effective monitoring. The Flight Safety Foundation (FSF) document provides one example of how to manage cognitive resources by using the concept of Area of Operational and training data should also be collected and used to revise definitions of flight crew member roles and responsibilities to ensure their effectiveness. The goal is for an operator to have a global and consistent approach for monitoring issues and to ensure that the SOPs do not conflict with each other.

[5] Overall crew performance: Overall, crew members should perform well as risk managers. Example performance includes Flight, Cabin, Ground crew as well as their interactions with ATC

Non-adherence to SOPs and SOPs cross verification were cited in 42% of LOC-I accidents. Another factor contributing to the LOC-I accident to occur was the incorrect response by the flight crew to the situation faced, which puts the aircraft in a position that is either at the limits of recoverable or beyond recovery. Therefore, it is recommended that all operators integrate in their training program latest guidance and best practices related to upset prevention and recovery training (UPRT). IATA provides free access to its UPRT implementation guide through the following link: Upset Recovery guidance material. Also, emphasis should be on flight crew to increase their ability to not only recognize and avoid situations that can lead to airplane upsets but also to improve their ability to recover control of an airplane that diverges from a crew's desired airplane state.

Failure to prevent or recover from a sudden onset situation may induce acute stress, startle, automation surprise, and pilot confusion, which can delay an effective response. Stress can downgrade physical and mental performance to the point where pilots can freeze at the controls or repeat unsuitable recovery actions. Pilots' resilience to stressful situations could be improved by stress exposure training.

Loss of situational awareness and control of the aircraft during conditions of low speed, high pitch and high bank angle have also been identified as factors in accidents attributed to human error. It is essential that the flight crew have the knowledge about the importance of the AoA in order to recover from stall events. Since AoA awareness and knowledge are key to avoiding LOC-I accidents, it is recommended that all operators emphasize in their training the concept of AoA. Such training provides pilots with the ability and skills to recognize conditions that increase the likelihood of a stall event if not effectively managed, and to apply the correct flight control inputs that are required to maintain or regain control of the aircraft.

Evidence shows that aircraft systems failure, which interfered with normal flight management and/or directly with aircraft control, were a threat potentially leading to LOC-I accidents. This includes:

- Engine failure contained and uncontained
- Flight control or flight control computer malfunction
- Major electrical failure
- Flight instruments loss or malfunction

Events outside the influence of the flight crew, which have the potential to reduce the safety margins of a flight, are considered threats. These require flight crew attention and making timely and correct decisions to ensure the continued safety of the flight. In the Environmental and Airline Threats contributing factors, adverse meteorological conditions, wind shear and aircraft malfunction were cited as common factors. IATA has developed the 1st edition of the Environmental Factors Affecting Loss of Control In-Flight: Best Practice for Threat Recognition & Management with the aim of providing a point of reference for understanding and mitigating the risk of LOC-I as a result of environmental factors encountered in flight.

To avoid LOC-I accidents, it is recommended that pilots receive appropriate training for both malfunction recognition and proper response to it; hence, operators should provide enhanced and more realistic training for the appropriate pilot reactions to engine malfunctions.

Adequate classroom and simulator training should be provided to pilots to increase their skills, discipline and knowledge academically as well as to help pilots develop the ability to manage the aircraft state through the correct implementation of skill-based behavior.

Another important element of continued reduction in the number of LOC-I accidents is the collection and sharing of flight data to identify hazards ahead of time and mitigate the risks that can lead to an accident. The use of Flight Data Monitoring (FDM) is essential as it identifies potential hazards in flight operations and provides accurate quantitative data. FDM is also the best-known indicator of UAS like operation outside aircraft limitations. It is also essential as it strongly contributes to improve flight safety and increase operational benefits, and while it may not be required on all aircraft, it is strongly recommended as part of an overall SMS program. More information on FDM can be found in the next section (Section 9).

Section 9—Flight Data Monitoring

The best potential source of operational data is the operator's own FDM, Flight Data Analysis (FDA), or Flight Operational Quality Assurance (FOQA) programs. The aim of FDM is to improve safety through an analysis of information downloaded from an aircraft's onboard computer at the end of every flight. This information can be used to identify trends and discover issues that might develop into a serious safety hazard.

The routine downloads and analysis of recorded flight data has been used by operators for many years as a tool to:

- Identify potential hazards in flight operations
- Evaluate the operational environment
- Validate operating criteria
- Set and measure safety performance targets
- Monitor SOP compliance
- Measure training effectiveness

In non-routine circumstances, when an incident occurs, the data can be used to debrief the pilots involved and inform management. In a de-identified format, the incident data can also be used to reinforce training programs, raising awareness among the pilot group as a whole, including FDM gatekeeper.

Data collection and analysis can provide information regarding threats and hazards and identify potential weaknesses of an operator. As indicated in the jointly agreed IATA/ICAO/IFALPA Evidence-based Training (EBT) Implementation Guide, the collection and analysis of operational data (i.e., the characteristics of the operator, reporting systems, flight data analysis, flight deck observation, data-sharing group outcomes) helps to develop relevant and effective training programs by managing the most relevant threats and errors based on evidence collected in operations and training.

IATA encourages operators to produce a set of standardized FDM safety measures and precursors related to potential LOC-I accidents (i.e., pitch high during climb, excessive roll attitude or roll rate, takeoff configuration warning, thrust asymmetry, non-compliance with SOPs, and others). With an established standardized FDM, operators can monitor aircraft parameters and identify common factors leading to LOC-I events. Furthermore, FDM will not only enable operators to identify trends on LOC-I events and precursors, but also enable them to review procedures and training programs to reduce such events. FDM tools should be used as a primary source, whenever possible.

In addition to an FDM program, preventative and recovery risk control measures should be encouraged and implemented by regulators, pilots, operators and manufacturers to help mitigate or avoid the serious consequences of LOC-I.

Section 10—Mitigation Strategies

This section provides prevention strategies and recommendations for operators to minimize the likelihood of LOC-I accidents. The awareness of potential precursors that could lead to LOC-I and the development of means to address them is essential. While aircraft malfunction and meteorology were contributing factors, the latent conditions of training, checking, SOPs leading to manual handling, communication and application of SOPs are high on the errors list leading to the undesired aircraft states of speed and vertical/lateral flight path deviations. Therefore, pilots must develop skills and disciplines to increase their awareness of situations where LOC-I can occur, recognize when an airplane is approaching a stall, has stalled, or is in an upset condition, and initiate prompt corrective actions to prevent and recover the aircraft. Pilots must also recognize the upset at its earliest stages and initiate prompt recovery action to prevent the development of an unrecoverable LOC-I environment. A number of recommendations extracted from the 2018 IATA Safety Report are listed below to aid in LOC-I risk reduction.

Recommendations to operators:

- Conduct training on energy management in a variety of scenarios and flight phases, including, but not limited to: engine failure, thrust loss, and non-normal engine configurations.
- Provide classroom and simulator training to flight crew on regular basis
- Further emphasis of the implementation of policy outlining the standards by which organizations will act in regard to safety, the following of SOPs, proper training practices, and the establishment of positive safety cultures.
- Implementation of IOSA standards.
- Include and emphasize Pilot Monitoring of aircraft flight path and system training and encourage manual intervention as appropriate.
- Reinforce workload management and task allocation and prioritization.
- Ensure operations are conducted in accordance with SOPs.
- Ensure flight crews have the necessary communication and Crew Resource Management (CRM) skills.
- Ensure that training is completed within the Validated Training Envelop of the FSTD- refer to IATA Guidance Material and Best Practices for The Implementation of Upset Prevention And Recovery Training (REV 2)
- Consult with the 3rd edition of the Airplane Upset Prevention and Recovery Training Aid (AUPRTA), which this document emphasizes on both the recognition and prevention,
- Incorporate, where applicable, the Commercial Aviation Safety Team (CAST) safety enhancements (SEs). All SEs, including the SEs 192-211 19 SEs (192-211) on Airplane State Awareness are available on Skybrary: http://www.skybrary.aero/index.php/Portal:CAST_SE_Plan

Section 11—Conclusion

This LOC-I analysis report used data from 64 LOC-I accidents that resulted in 2,462 fatalities during the last ten-year period between 2009 through 2018. LOC-I was the most frequent fatal accident category in that period, resulting in the highest number of fatalities and second highest number of hull loss accidents.

LOC-I accidents are a complex accident category in that they can result from numerous contributing factors, either acting individually or (more often) in combination. This report reveals a multitude of factors leading up to a LOC-I accident. Very often, the trigger that initiates a LOC-I accident sequence is an external environmental factor, predominantly meteorological. Likewise, the following human performance deficiencies frequently compounded the initial upset and precluded an effective recovery until it was too late:

- Automation and flight mode confusion
- Distraction
- Startle effect
- Loss of situational awareness

Aircraft systems failure, which interfered with normal flight management and/or directly with aircraft control, was also cited as a threat potentially leading to LOC-I accidents. This includes:

- Improper, inadequate or absent training
- Contained engine failure and powerplant malfunction
- Loss of control function or of a significant element of the flying controls
- Major electrical failure
- Loss or malfunction of critical flight instrument displays

The ability of pilots to prevent and overcome LOC-I is through dedicated focus on increasing awareness of precursors leading to such an event; the development of skills and disciplines to recognize the upset early in its development or taking definitive action to recover from the upset. Training with an emphasis on awareness and prevention provides pilots with the skills to recognize conditions that could lead to an upset event if not effectively managed.

Moreover, LOC-I is often linked to an operation of the aircraft well below stall speed. Even with fully protected aircraft, stall and upset awareness, prevention and recovery training, as well as approach to stall recovery training, needs to be addressed on a regular basis. Furthermore, amongst others, inadequate pre-flight briefing/preparation, non-compliance with SOPs and inflight decision making are factors which suggest poor judgement, CRM and/or inadequate training. Therefore, enhanced training on CRM should focus on situation awareness, communication skills, effective flight path monitoring for prevention and threat mitigation strategies, teamwork, task allocation and prioritization, decision-making and error management within a comprehensive context of SOPs.

In addition to focusing more efforts on training, the industry should implement other preventative and recovery risk control measures to help minimize the likelihood of LOC-I accidents. CAST identified a number of intervention strategies and recommendations to limit LOC-I events.

By definition, LOC-I can be avoided, and it is hoped that the content of this report will help achieve that goal.

Appendix A — Phases of Flight

Takeoff (TOF) This phase begins when the crew increases the thrust for lift-off; it ends when an 'Initial Climb' is established or the crew initiates a 'Rejected Takeoff' phase.

Initial Climb (ICL) This phase begins at 35 feet above the runway elevation; it ends after the speed and configuration are established at a defined maneuvering altitude or to continue the climb for cruising. It may also end by the crew initiating an 'Approach' phase. Note: maneuvering altitude is that needed to safely maneuver the aircraft after an engine failure occurs, or predefined as an obstacle clearance altitude. Initial Climb includes such procedures applied to meet the requirements of noise abatement climb or best angle/rate of climb.

En Route Climb (ECL) This phase begins when the crew establishes the aircraft at a defined speed and configuration, enabling the aircraft to increase altitude for cruising; it ends with the aircraft establishing a predetermined constant initial cruise altitude at a defined speed or by the crew initiating a 'Descent' phase.

Cruise (CRZ) This phase begins when the crew establishes the aircraft at a defined speed and predetermined constant initial cruise altitude and proceeds in the direction of a destination; it ends with the beginning of the 'Descent' phase for an approach or by the crew initiating an 'En Route Climb' phase.

Descent (DST) This phase begins when the crew departs the cruise altitude for an approach at a destination; it ends when the crew initiates changes in aircraft configuration and/or speeds to facilitate a landing on a specific runway. It may also end by the crew initiating an 'En Route Climb' or 'Cruise' phase.

Approach (APR) This phase begins when the crew initiates changes in aircraft configuration and/or speeds enabling the aircraft to maneuver to land on a specific runway; it ends when the aircraft is in the landing configuration and the crew is dedicated to land on a specific runway. It may also end by the crew initiating a 'Go-around' phase.

Go-around (GOA) This phase begins when the crew aborts the descent to the planned landing runway during the Approach phase; it ends after speed and configuration are established at a defined maneuvering altitude or to continue the climb for the purpose of cruise (same as the end of 'Initial Climb').

Landing (LND) This phase begins when the aircraft is in the landing configuration and the crew is dedicated to touch down on a specific runway; it ends when the speed permits the aircraft to be maneuvered by means of taxiing for arrival at a parking area. It may also end by the crew initiating a "Go-around" phase.

Appendix B — IATA Regions

IATA determines the accident region based on the operator's home country, as specified in the operator's Air Operator Certificate (AOC). For example, if a Canadian-registered operator has an accident in Europe, this accident is counted as a "North American" accident.

Region	Country
AFI	Angola
	Benin
	Botswana
	Burkina Faso
	Burundi
	Cameroon
	Cape Verde
	Central African Republic
	Chad
	Comoros
	Congo, Democratic Republic of
	Congo
	Côte d'Ivoire
	Djibouti
	Equatorial Guinea
	Eritrea
	Ethiopia
	Gabon
	Gambia
	Ghana
	Guinea
	Guinea-Bissau
	Kenya
	Lesotho
	Liberia
	Madagascar
	Malawi
	Mali
	Mauritania
	Mauritius
	Mozambique
	Namibia
	Niger
	Nigeria
	Rwanda
	São Tomé and Príncipe
	Senegal
	Seychelles
	Sierra Leone
	Somalia
	South Africa
	South Sudan
	Swaziland
	Tanzania, United Republic of
	Togo
	Uganda
	Zambia
	Zimbabwe
ASPAC	Australia[1]
	Bangladesh
	Bhutan
	Brunei Darussalam
	Cambodia
	Fiji Islands
	India
	Indonesia
	Japan
	Kiribati
	Korea, Republic of
	Lao People's Democratic Republic
	Malaysia
	Maldives
	Marshall Islands
	Micronesia, Federated States of
	Myanmar
	Nauru
	Nepal
	New Zealand[2]
	Pakistan
	Palau
	Papua New Guinea
	Philippines
	Samoa
	Singapore
	Solomon Islands
	Sri Lanka
	Thailand
	Timor-Leste
	Tonga
	Tuvalu
	Vanuatu

Region	Country
	Vietnam
CIS	Armenia
	Azerbaijan
	Belarus
	Georgia
	Kazakhstan
	Kyrgyzstan
	Moldova, Republic of
	Russian Federation
	Tajikistan
	Turkmenistan
	Ukraine
	Uzbekistan
EUR	Albania
	Andorra
	Austria
	Belgium
	Bosnia and Herzegovina
	Bulgaria
	Croatia
	Cyprus
	Czech Republic
	Denmark[3]
	Estonia
	Finland
	France[4]
	Germany
	Greece
	Holy See (Vatican City State)
	Hungary
	Iceland
	Ireland
	Italy

Region	Country
	Israel
	Kosovo
	Latvia
	Liechtenstein
	Lithuania
	Luxembourg
	Macedonia, the former Yugoslav Republic of
	Malta
	Monaco
	Montenegro
	Netherlands[5]
	Norway
	Poland
	Portugal
	Romania
	San Marino
	Serbia
	Slovakia
	Slovenia
	Spain
	Sweden
	Switzerland
	Turkey
	United Kingdom[6]
LATAM/ CAR	Antigua and Barbuda
	Argentina
	Bahamas
	Barbados
	Belize
	Bolivia
	Brazil
	Chile
	Colombia

Region	Country
	Costa Rica
	Cuba
	Dominica
	Dominican Republic
	Ecuador
	El Salvador
	Grenada
	Guatemala
	Guyana
	Haiti
	Honduras
	Jamaica
	Mexico
	Nicaragua
	Panama
	Paraguay
	Peru
	Saint Kitts and Nevis
	Saint Lucia
	Saint Vincent and the Grenadines
	Suriname
	Trinidad and Tobago
	Uruguay
	Venezuela
MENA	Afghanistan
	Algeria
	Bahrain
	Egypt
	Iran, Islamic Republic of
	Iraq
	Jordan
	Kuwait
	Lebanon

Region	Country
	Libya
	Morocco
	Oman
	Palestinian Territories
	Qatar
	Saudi Arabia

Region	Country
	Sudan
	Syrian Arab Republic
	Tunisia
	United Arab Emirates
	Yemen
NAM	Canada

Region	Country
	United States of America[7]
NASIA	China[8]
	Mongolia
	Korea, Democratic People's Republic of

[1]Australia includes:
Christmas Island Cocos (Keeling) Islands Norfolk Island Ashmore and Cartier Islands Coral Sea Islands Heard Island and McDonald Islands
[2]New Zealand includes:
Cook Islands Niue Tokelau
[3]Denmark includes:
Faroe Islands Greenland
[4]France includes:
French Guiana French Polynesia French Southern Territories Guadalupe Martinique Mayotte New Caledonia Saint-Barthélemy Saint Martin (French part) Saint Pierre and Miquelon Reunion Wallis and Futuna
[5]Netherlands include:
Aruba

Curacao Sint Maarten
[6]United Kingdom includes:
Akrotiri and Dhekelia Anguilla Bermuda British Indian Ocean Territory British Virgin Islands Cayman Islands Falkland Islands (Malvinas) Gibraltar Montserrat Pitcairn Saint Helena, Ascension and Tristan da Cunha South Georgia and the South Sandwich Islands Turks and Caicos Islands British Antarctic Territory Guernsey Isle of Man Jersey
[7]United States of America include:
American Samoa Guam Northern Mariana Islands Puerto Rico Virgin Islands, U.S. United States Minor Outlying Islands
[8]China includes:
Chinese Taipei Hong Kong Macao

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