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NOTICE

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Senior Vice-President Foreword

Gilberto Lopez Meyer
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Dear colleagues,

Safety is our industry's top priority and we saw continued strong progress last year, as some 4.5 billion passengers travelled safely on 46.8 million flights. The following industry-level figures confirm that flying is safe and getting safer:

- In 2019, the number of total accidents and fatal accidents both declined compared to 2018 and to the average of the preceding five years (2015-2019).
- A similar trend was observed for the all accident rate, the jet hull loss rate and the turboprop hull loss rate.
- The fatality risk fell to nearly half what it was in 2018 and in the average of the preceding five years. Based on the 2019 fatality risk of 0.09 per million sectors, a person could travel by air every day for 535 years before experiencing an accident in which at least one passenger was killed and every day for 29,586 years before experiencing a 100% fatal accident.
- Airlines on the IATA Operational Safety Audit (IOSA) registry continued to significantly outperform their non-IOSA counterparts. The all accident rate for IOSA airlines was 0.92 per million sectors; for non-IOSA airlines it was 1.63.

The total of eight fatal accidents recorded in 2019 was in line with the average of the preceding five years (8.2), while the number of fatalities in 2019 (240) represented a decrease compared to the average of 303.4 fatalities for the preceding five years.

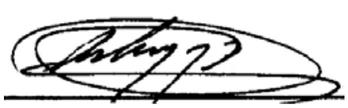
Of the eight fatal accidents, six were passenger flights, including the Ethiopian Airlines B737 MAX crash in March (157 passengers and crew were killed in that crash). This accident, along with the fatal 29 October 2018 crash of a Lion Air B737 MAX that resulted in 189 deaths, prompted the grounding of all Boeing MAX airplanes.

Loss of Control – In-flight (LOC-I) accidents continued to impose a huge toll in terms of lives lost. Just four such events accounted for around 80% of fatalities in 2019. LOC-I events also accounted for around two-thirds of fatalities from 2015 to 2019. On the other hand, the industry experienced zero Controlled Flight into Terrain (CFIT) accidents in 2019. Such accidents accounted for 11% of fatalities in the last five years.

It is our privilege to offer you this 56th edition of the IATA Safety Report. I encourage you to share the vital information contained in these pages with your colleagues. I would like to thank the Accident Classification Technical Group (ACTG), the Safety, Flight and Ground Operations Advisory Council (SFGOAC), Safety Group (SG), the Cabin Operations Safety Technical Group (COSTG), and all IATA staff involved for their cooperation and expertise, essential for the creation of this report.

"We must plant the seeds of training and just culture in order to have a harvest of safe behaviors."

Chairman Foreword



Ruben Morales
Chairman, IATA Accident Classification Technical Group

We ended 2019 with the Boeing 737 MAX fleet still grounded globally after two fatal accidents and with no clarity on when the type will be permitted to return to service. The loss of ET 302 accounted for 157 of the 240 fatalities to passengers and crew in 2019.

Loss of Control – In-flight (LOC-I) accidents resulted in the highest number of fatalities again this year owing to the high fatality risk of such events. The four LOC-I accidents (including ET 302), accounted for more than three-quarters of the fatalities in 2019. The industry should continue efforts to implement recommendations intended to reduce LOC-I. Even though mitigating LOC-I occurrences will only marginally reduce the total number of global aircraft accidents, it will significantly reduce the overall number of aircraft accident fatalities.

On the positive side, 2019 showed an improvement with 1.13 accidents per million sectors, compared to the five-year rate (2014-2018) of 1.56 accidents per million sectors and the 10-year rate of 1.96 accidents per million sectors.

During the accident classification work, the experts from the IATA Accident Classification Technical Group (ACTG) made several recommendations to improve safety. These were related to selection, training and competence management of all safety critical staff, but more specifically of flight crew.

Some of the top countermeasures that could have been taken to prevent accidents are better monitoring and crosschecking, in-flight decision-making and leadership. Operators should equip and train their crews and the support organizations behind them to be able to make considered, timely and risk-based decisions.

I wish to thank the members of the ACTG for all their efforts, dedication and shared expertise, which make this report possible.

Safety Report 2019 Executive Summary

Yearly accident rates indicate a decrease in both the total number of accidents as well as the global accident rate in 2019. The full year 2019 accident rate, which includes all accidents, was 17% lower than that in 2018. The number of fatal accidents also decreased from 11 accidents in 2018 to 8 in 2019.

It is true to say that in 2019, the aviation industry saw continued strong progress, as some 4.5 billion passengers travelled safely on 46.8 million flights, with only 240 on board fatalities in 8 accidents.

Of the 53 aircraft accidents and 240 fatalities in 2019, International Air Transport Association (IATA) member airlines had three fatal accidents, which accounted for 201 fatalities. In 2019, IATA member airlines continued to trend lower than the industry as a whole at 0.87 accidents per million sectors versus 1.13, a pattern that is also reflected in the five-year average.

Over the last decade, as detailed in **Section 2, Decade Review**, the industry continued its 10-year trend of declining accident rates and fatality risks. All indicators show a 10-year downward trend. IATA is focused on continuously reducing fatality risks in the industry.

Section 3, 2019 Review, shows accidents in the runway environment persist. There were 17 (32%) Runway Excursions, which accounted for three fatalities, indicating an area where further improvements can be made. The ICAO Global Runway Safety Action Plan released in November 2017 identifies the stakeholder mitigations that must be actioned to address this issue.

The accident categories with fatalities in 2019 were:

- Loss of Control – In-flight (4) with 191 fatalities
- Hard Landing (1) with 41 fatalities
- Other End State (1) with 5 fatalities
- Runway Excursion (2) with 3 fatalities

The number of non-fatal accidents by category in 2019 were:

- Runway Excursion (15)
- In-flight Damage (8)
- Gear-up Landing/Gear Collapse (6)
- Tail Strike (5)
- Ground Damage (4)
- Hard Landing (3)
- Other End State (2)
- Undershoot (1)

The accident rate continues its downward trend, not only in terms of overall accidents, but also for Jet hull losses and fatal accidents.

- The global accident rate in 2019 was 1.13 per million sectors, compared to 1.36 in 2018.
- The fatality risk was 0.09 in 2019 compared to 0.17 in 2018.
- The Jet Hull Loss rate was 0.15 in 2019 vs 0.18 hull losses per million sectors in 2018.
- Six of the eight fatal accidents in 2019 were passenger operations, which accounted for 97% of all fatalities.
- Loss of Control – In-flight (LOC-I) and Hard Landing caused the highest number of fatalities in 2019. LOC-I resulted in 80% of total fatalities in 2019.
- There were no Controlled Flight into Terrain (CFIT) accidents in 2019. Despite the absence of CFIT accidents in 2019, CFIT accidents often have catastrophic results when they occur, with very few, if any, survivors. Therefore, there is a historic fatality risk associated with this accident category.
- 32% of the air transport commercial accidents in 2019 occurred in North America (NAM), followed by 17% in Africa (AFI) and 15% in the Asia-Pacific (ASPAC) region.
- In 2019, 58% of the air transport commercial accidents involved jets, the remaining 42% involved turboprops. The global turboprop fleet is around one-sixth the size of the jet fleet.
- The full-year accident rate for IOSA-registered carriers in 2019 was lower than the rate for non-IOSA carriers (0.92 vs 1.63).
- IATA membership and IOSA accreditation for non-IATA members continued a strong correlation with improved safety performance.

The five-year data analysis in **Section 4, 2015-2019 Analysis**, shows that the all-accident rate, hull-loss rate, fatal accident rate and fatality risk are all declining. Not only is the rate of accidents measured against sectors flown reducing, but the total number of accidents is in decline.

Between 2015 and 2019:

- The most common accident category was Runway/Taxiway Excursion (74), followed by In-flight Damage (39), Hard Landings (38) and Gear-up Landing/Gear Collapse (38).
- LOC-I was the most common fatal accident. This single accident category had 19 fatal accidents over the reporting period and was responsible for 780 deaths.
- The top three latent conditions contributing to accidents were Regulatory Oversight, Safety Management and Flight Operations.
- The top environmental and airline threats were Adverse Weather Conditions, Wind/Wind Shear/Gusts, Airport Facilities, and Aircraft Malfunction.
- The top three errors were Manual Handling/Flight Controls, Standard Operating Procedures (SOPs) Adherence/Cross-verification and Callouts.
- The most common undesired aircraft state, from which a recovery was still possible, was Long/Floated/Bounced/Firm/Off-Center/Crabbed Landing, followed by Vertical, Lateral or Speed Deviation, with Unstable Approaches the third most common state.
- The most common countermeasures absent in the accidents were Overall Crew Performance, followed by Monitor/Cross-Check and In-flight Decision-Making/Contingency Management.

Section 5, Regional Analysis, provides analysis of accidents in each IATA region.

Between 2015 and 2019:

- The ASPAC region and ASPAC-based operators had the highest total number of accidents, 72 and 69 respectively, over the past five years. This represents 24% of the total accidents worldwide.
- AFI had a five-year accident rate of 5.33 per million sectors, followed by Commonwealth of Independent States (CIS) with 4.48 accidents per million sectors.
- AFI had two fatal accidents in 2019 including the loss of ET 302, the accident that led to the worldwide grounding of the B737 MAX. This was the region's first fatal jet accident since 2015. The jet fatal accidents for this region was 1.39, which was an increase compared to the rate of 0.00 in 2018.
- Runway Excursion had the highest frequency of occurrence with 25% of total accidents.
- LOC-I had the highest number of fatal accidents with 51% of total fatal accidents.
- 57% of total accidents occurred in the landing phase of flight.

In 2019:

- Europe (EUR), ASPAC, Middle East and North Africa (MENA), and Northern Asia (NASIA) operators' accident rates were below the global rate of 1.13 per million sectors.
- ASPAC operators had eight nonfatal accidents in total, including one hull loss and no fatal accidents. The ASPAC operator accident rate of 0.99 in 2019 fell from the 2018 accident rate of 2.01. The most common End State involving ASPAC operators was Runway/Taxiway Excursions (6 accidents).
- AFI operators had nine accidents in total, including two fatal accidents resulting in 176 fatalities. The two fatal accidents were as a result of LOC-I. The AFI operator accident rate was 6.03 in 2019, up from 3.50 in 2018. The most common End State involving AFI operators was In-flight Damage (3 accidents).
- NAM operators had 17 accidents, including two fatal accidents resulting in four fatalities. One of the fatal accidents sustained damage, while the other was a hull loss. The fatal accidents were as a result of a Runway Excursion and LOC-I. The NAM operator accident rate went up from 0.93 in 2018 to 1.27 in 2019.
- CIS operators had six accidents, including five hull losses, four of which were fatal resulting in 60 fatalities. The fatal accidents were as a result of LOC-I, Runway Excursion, Hard Landing, and Other End State. The CIS operator accident rate in 2019 was 4.04, down from 5.58 in 2018.
- CIS operators recorded half the fatal accidents in 2019 and a fatal accident rate of 2.69, which was an increase compared to 1.40 in 2018.
- EUR operators had five accidents, with no hull losses and no fatalities. The EUR operator accident rate was 0.50 in 2019 compared to 0.92 in 2018.
- LATAM operators had six accidents, including one hull loss and no fatal accidents. The LATAM operator accident rate in 2019 was 1.73 compared to 2.39 in 2018. The most common end state involving operators based in the LATAM region was Runway/Taxiway Excursion (3 accidents).
- MENA operators had one accident, which was not a hull loss or fatal. The 2019 MENA operator accident rate was 0.44 compared to 0.90 in 2018. The end state of that accident was classified by the Accident Classification Technical Group (ACTG) as Gear-up Landing/Gear Collapse.
- NASIA operators had one nonfatal hull loss accident. The NASIA operator accident rate was 0.15 in 2019 compared to 0.32 in 2018. The end state of that accident was classified by ACTG as Other End State.

Section 6, Cargo Accidents 2019:

- There were five Cargo aircraft accidents, two of which were fatal, resulting in eight onboard fatalities.
- 60% of the Cargo accidents involved NAM operators; 20% involved AFI operators and 20% involved CIS operators.
- 60% of the Cargo accidents occurred during the approach phase of flight and 40% occurred on landing.

Section 7, Cabin Safety:

During 2019, further cabin-related classifications have been added to the IATA Accident Data Exchange (ADX) database to give more relevance to Cabin Crew and Cabin Safety Training.

In addition to the end state classifications highlighting the cabin crew actions taken to evacuate or disembark passengers, these new classifications indicate the time the cabin crew had to prepare for the emergency as well as whether any additional preparations were carried out to the normal takeoff or landing cabin secure checks.

Of the 2019 accidents, where the narrative provided enough information to assess against these classifications, 83% occurred during what cabin crew believed to be a normal takeoff or landing with no warning provided, while 97% did not allow for any additional procedures to be carried out before the evacuation.

The IATA Cabin Operations Safety Best Practices Guide was updated during 2019 to include more detailed cabin safety risk assessments, guidance on introducing a cabin Line Operations Safety Audit (LOSA), examples of cabin safety performance indicators and targets, and the management of a Cabin Safety Action Group.

The principles detailed in the IATA Cabin Operations Safety Best Practices Guide help support an effective cabin Safety Management System (SMS).

Section 8: Report Findings and IATA Prevention Strategies

ACTG members reviewed each accident that occurred in 2019 and assigned the classifications that are used in this report. While causal factors tend not to change dramatically from one year to the next, some key areas do arise. The ACTG has identified a few of these areas of concern that need to be addressed by industry stakeholders. Section 8, therefore, contains guidelines on some specific accident categories and a summary of the ACTG recommendations and discussion points.

Section 9: STEADES Analysis

Safety Trend Evaluation, Analysis & Data Exchange System (STEADES) analysis focused on updating the safety hazard awareness in one area needing more detailed scrutiny in the context of the global fleet increase: Maintenance Errors.

This in-depth study was completed by the Global Aviation Data Management (GADM) team in 2019, illustrating an overview in global occurrences of Maintenance Errors from Q1 of 2013 to Q2 of 2018.

Recommendations from the study include the development of a global standardized reporting system, ensuring a more inclusive and accurate capturing of reported maintenance occurrences to enable identification of the top safety issues concerning Maintenance Errors.

IATA Safety Strategy

A new IATA Safety and Security Strategy is being developed for delivery by 2023. Its ambition is to continuously improve safety and security performance through effective risk management, earning the industry the license to grow.

The Safety and Security Strategy includes five building blocks specifically related to safety. This strategy aims to deliver a cohesive approach to managing safety risks and covers the following areas:

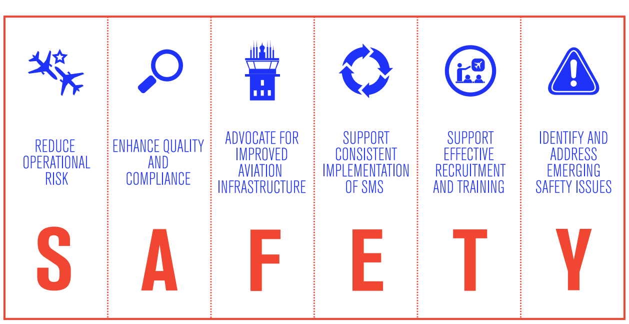
1. A**viation Data Center** for the identification of macro risks across the aviation system
2. **Center of Excellence** to develop and promote industry best practices that enable a system-wide approach to managing identified safety risks
3. **Incentivizing new technology** development to mitigate safety risks and support continuous improvement in safety performance
4. **Capacity building** through the engagement of States and intergovernmental organizations to build capacity in lower maturity countries
5. **High-impact event support** to provide airlines with tools that enable them to return to normal operations after high-impact events

The strategy is being developed in consultation with the IATA Safety Group (SG) and is endorsed by our Safety, Flight and Ground Operations Advisory Committee (SFGOAC).

With the implementation of this new strategy, IATA will work toward achieving its set goal for 2020 of reducing the 5-year rolling average accident rate per million flights compared to 2019.

While the new IATA Safety and Security Strategy evolves, we remain focused on continuously driving enhancements in six key priority areas.

IATA PRIORITIES



The activities related to these areas focus on specific organizational and operational safety issues. IATA works closely with industry stakeholders to ensure each of these pillars is leveraged to deliver key safety outcomes.

1. Reduce operational risk
2. Enhance quality and compliance
3. Advocate for improved aviation infrastructure
4. Support consistent implementation of Safety Management Systems (SMS)
5. Support effective recruitment and training
6. Identify and address emerging safety issues

Each of these six key areas breaks down into several sub-categories to address specific aspects of the strategy.

Aviation security is also key to maintaining operations resilient to threats. Some of the work carried out by IATA in this area is described in this section beginning on page 18.

B737 MAX

The prolonged grounding of the global B737 MAX fleet continues to significantly disrupt MAX operators and the commercial aviation industry as a whole. Many MAX operators have removed the aircraft from their schedules until there is better clarity around the timing of its return to service; at the time of writing, this remains unclear.

To facilitate timely updates from the Federal Aviation Administration (FAA) and Boeing, as well as an open dialogue among all operators and lessors that have the MAX in their fleet or on order, IATA held two summits in 2019.

The key takeaways from each summit were:

- Public and employee confidence in the B737 MAX will be critical to its successful return to service.
- Mutual recognition of aircraft certification is critical, not only for the B737 MAX, but for all future aircraft.

IATA will continue to:

- Advocate for the alignment and coordination of State validation requirements on a global basis.
- Defend the longstanding global mutually recognized aircraft certification process.
- Support all airlines in restoring confidence in the B737 MAX.

REDUCE OPERATIONAL RISK

IATA remains focused on its top safety priorities, which include Runway Safety, Controlled Flight into Terrain (CFIT), Loss of Control–In-flight (LOC-I) among others, while continuing to promote the implementation of new safety initiatives.

Based on analyses of accident data for commercial air transport operations, IATA has identified high-risk accident categories to determine the topics for safety analysis.

Controlled Flight into Terrain

Although CFIT accidents represented only 1% of all commercial aircraft accidents and 8% of fatal accidents during the last five years (2015-2019), this risk area was the third-highest fatal accident category after LOC-I and Runway Excursion. IATA continues its efforts to reduce the risks of CFIT accidents by providing awareness of CFIT accidents and proposing prevention measures to further reduce this type of accident. Other industry partners took strong measures to address such occurrences, which involved the requirement and installation of advanced terrain alerting systems (e.g., Enhanced Ground Proximity Warning System (EGPWS), Ground Collision Avoidance System).

This advanced technology represents an efficient countermeasure to CFIT by enhancing the pilot's situational awareness regarding environmental threats. As long as this technology on the aircraft has a Global Positioning System (GPS) connection, which is the case for most airlines, it is simply a case of regular uploading of software updates of the terrain/obstacles/runway database. Other efforts include the development of guidance material to assist operators in implementing specific training programs and procedures relating to EGPWS. As such, it is vital that operators ensure that their EGPWS databases are regularly updated – something that the recent IATA and Honeywell jointly produced guidance on performance assessment of pilot response to Enhanced Ground Proximity Warning System (EGPWS) highly recommended.

Loss of Control – In-flight

Although the LOC-I category represented only 8% of all accidents during the last five years (2015-2019), it resulted in the highest percentage of fatal accidents (51%). Therefore, LOC-I remains one of the most significant contributors to fatal accidents worldwide.

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 a range of interferences, including engine failures, icing or stalls. It is one of the most complex accident categories, involving numerous contributing factors that act individually or, more often, in combination. Reducing this accident category, through understanding of causes and possible intervention strategies, is an industry priority.

IATA has developed an accident analysis report using data from LOC-I accidents. By definition, LOC-I can be avoided, and it is hoped that the content of the interactive LOC-I Accident Analysis Report will help achieve that goal. This report presents data from 64 LOC-I accidents that occurred over 10 years, spanning 2009 through 2018. Some of the recommendations for operators to consider are:

- Conduct training on energy management in a variety of scenarios and flight phases, including, but not limited to, engine failure, thrust loss, and abnormal engine configurations.
- Provide classroom and simulator training to flight crew on a regular basis.
- Include and emphasize training for pilot monitoring of the aircraft flight path and system, and encourage manual intervention, as appropriate.
- Reinforce workload management as well as task allocation and prioritization.
- Ensure operations are conducted in accordance with SOPs.
- Ensure training is completed within the validated training envelop of the Flight Simulation Training Devices (FSTD).
- Refer to IATA Guidance Material and Best Practices for the Implementation of Upset Prevention and Recovery Training (REV 2).
- Consult the 3rd edition of the Airplane Upset Prevention and Recovery Training Aid (AUPRTA), which emphasizes both recognition and prevention.
- Incorporate, where applicable, the Commercial Aviation Safety Team (CAST) safety enhancements (SEs). All SEs, including 192-211 on Airplane State Awareness, are available on Skybrary.

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.
- Taking definitive action to recover from an upset.
- Enhanced monitoring of aircraft and 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).
- Emphasize the briefing on pre-flight and, in certain phases, impending night or Instrument Meteorological Conditions (IMC) entries that complicate situational awareness 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).
- Constant awareness of stall margin throughout all phases of flight.

Download the [LOC-I Accident Analysis Report (pdf)] to get an evaluation of the risk factors from LOC-I accidents and information designed to aid the industry in the implementation of mitigation strategies.

Manual Handling Skills

As LOC-I is the most significant cause of fatal accidents in commercial aviation, IATA has decided to conduct a survey on aircraft handling and manual flying skills to capture subjective feedback from pilots about their manual flying practices during everyday line operations and during operator training. The survey was designed to cover the following four main sections:

- Pilot demographic information
- Airline automation policy
- Manual flying practices
- Training policy during both line operations and simulator sessions

The survey was sent to more than 8,000 people in the aviation industry, among which 5,650 completed the survey.

Considering the 42 questions together, the answers improve our knowledge of commercial pilots' practices in the fields of aircraft handling and manual flying by:

- Integrating pilots' commercial air transport operations experience on different types of aircraft into the analysis.
- Assessing the differences between various types of operations and/or networks.
- Benchmarking the differences between operators' policies about manual flying opportunities and automation usage in operations.
- Benchmarking the rationale for any manual flying limitations in operations.
- Getting pilots' subjective feedback regarding their ability and level of confidence with automation as related to the operational context.
- Getting pilots' subjective feedback about their competencies regarding flight path management (FPM) through manual control and flight path automation (FPA).
- Getting pilots' subjective feedback on the effectiveness of operator training to maintain and develop their above-mentioned competencies.

The survey outcome is substantive enough to draft comprehensive recommendations regarding operators' operational and training policies in the field of manual flying in an increasingly automated environment.

In particular, the analysis of the survey results helps us understand if increased automation contributes to over-reliance by the pilots on automation, and/or to some manual flying deficiencies or shortcomings through:

- Weighing the latent effects of manufacturers' recommendations and SOPs on pilots' ability to obtain and maintain appropriate manual flying skills.
- Analyzing the respondents' opinions on whether they consider that simulator training could adequately replace manual flying in a real operational context.
- Evaluating the effect of experience on pilots' training needs to maintain their flying skills.
- Gaining further insight on pilots who are operating in restrictive company cultures. Are their manual flying opportunities really reduced and, if so, to what extent?
- Assessing whether there is a need to adjust airline automation policy and/or SOPs in such a way that pilots have better opportunities to acquire and maintain manual flying skills without compromising flight safety, efficient flight operations, and/or passenger comfort.

The results of the survey and the recommendations will be published in 2020.

Mid-Air Collision

The likelihood of mid-air collisions has dropped dramatically thanks to the deployment of the Airborne Collision Avoidance System (ACAS) and other initiatives, such as the development of appropriate operational procedures and training initiatives for flight crews and Air Traffic Control (ATC).

ACAS/Traffic Collision Avoidance System (TCAS) indications are intended to help pilots avoid potential collisions. For the TCAS system to achieve its intended safety benefits, pilots must operate the system and respond to resolution advisories. IATA has reached out to aircraft operators in an effort to educate them about TCAS. As such, it is important for operators to consult with the IATA/EUROCONTROL guidance on the [assessment of pilot compliance to Traffic alert and Collision Avoidance System (TCAS) Resolution Advisories (RAs) using Flight Data Monitoring (FDM)]. This guide, which is based on International Civil Aviation Organization (ICAO) provisions and other applicable regulations, recommends that operators establish procedures to enhance flight crew responses following activation of TCAS RAs. This includes, but it is not limited to:

- Pilot response to RAs
- Pilot compliance with RAs
- Aircraft operations during RAs
- TCAS training
- RA reporting
- Use of Flight Operations Quality Assurance (FOQA) and FDM for monitoring and follow up of TCAS RA events

Runway Safety

Accidents related to runway excursions accounted for 25% of all accidents during the last five years (2015-2019), resulting in the second highest percentage of fatal accidents (11%) and 55 deaths. The Runway Excursion accident category represented 32% of all accidents in 2019 and included two fatal accidents with three fatalities.

Much of the improvement can be accredited to the work done by the industry and runway safety partners who have led many initiatives aimed at reducing the number of runway excursions globally. Despite these efforts, runway excursions remain one of the top challenges to aviation, with serious impacts in terms of safety and cost. A key consideration is to ensure effective braking, particularly when the runway surface conditions have deteriorated.

The assessment and reporting of Runway Surface Conditions (RSC) are being addressed by ICAO through the implementation of the new Global Reporting Format (GRF). This methodology has at its core a Runway Condition Assessment Matrix (RCAM) that enables:

- The harmonized assessment and reporting of runway surface conditions.
- Flight crew assessment of takeoff and landing performance based upon the reported runway surface conditions.

This methodology is for harmonized worldwide implementation, and will be globally applicable on 5 November 2020.

IATA continues to emphasize the importance of implementing GRF for assessing and reporting RSC at its Regional Coordination Group (RCG) meetings, IATA-dedicated workshops, and ICAO GRF symposiums and regional seminars. The 5 November 2020 applicability date for the GRF is fast approaching. Therefore, IATA, in partnership with ICAO, is working hard to help airlines achieve compliance with the upcoming mandate. IATA, together with ICAO, has developed an online course to help flight crew and dispatchers understand and use the new runway condition reporting requirements as outlined in ICAO Circular 355 (Assessment, Measurement and Reporting of Runway Surface Conditions) and ICAO Doc 10064 (Aeroplane Performance Manual (APM).

IATA is also working with EUROCONTROL and other stakeholders, in conjunction with industry support, to evaluate the relevance of the existing recommendations and update the European Action Plan for the Prevention of Runway Excursions (EAPPRE), taking into account the latest technological and procedural advancements to help reduce the accident rate and prevent runway excursions.

IATA is an active member of the Runway Safety Action Plan Working Group (RSAP-WG), which was established in 2017 with the aim of reviewing the RSP achievements, objectives and priorities, and to develop a Global Runway Safety Action Plan (GRSAP). The RSAP-WG has identified runway excursions and runway incursions as the main high-risk occurrence categories. The RSAP-WG is tasked to monitor and analyze runway safety data, including producing possibly deeper and more targeted analyses.

In 2020, IATA will produce an interactive accident analysis report using 10-year runway excursion data, with the aim of aiding the industry to implement mitigation strategies. This report will provide dynamic environment data from recent accidents, contain embedded interactive Excel graphs, and support a user-friendly methodology to analyze and visualize runway excursion accident data. The report user will be able to identify patterns, trends, and comparisons between data selections.

Emergency Response Planning

The global Emergency Response Planning (ERP) community met at the 2019 ERP Forum hosted by IATA in Montreal on 2-4 April 2019. During the ERP Forum, delegates discussed specific case studies such as the London Gatwick drone occurrence, opportunities to further collaborate, and best practices in relevant IATA publications. Perhaps more importantly, the ERP Forum delegates from IATA members expressed the wish to form a working group under the auspices of IATA and its governance structure. This would be the Emergency Response Planning Working Group (ERPWG).

Some of the main proposed objectives of the new ERPWG include:

- Acting as a center of excellence for all ERP matters worldwide worldwide, for both IATA member and nonmember airlines.
- Developing operating standards, training, guidance materials and services designed to improve ERP worldwide.
- Creating an annual conference to bring together senior airline ERP experts for information sharing and exchange, and to develop best practices for industry, among other items.

The ERP community also agreed on a proposed three-year work plan with the first goals for 2020 being to set up the ERPWG, hold the annual forum and conduct a full review of the IATA ERP best practices handbook.

The 2nd ERP Forum will be hosted by IATA in Montreal on 7-8 October 2020.

IATA Meteorological Project

IATA's Meteorological (Met) Project seeks to achieve two objectives:

- Develop a global, real-time, objective aircraft-sensed turbulence data sharing platform for airline operational use to mitigate the impact of turbulence.
- Improve weather forecasts by expanding the existing World Meteorological Organization (WMO) Aircraft-based Meteorological Data Relay program (AMDAR) to airlines from data sparse areas.

IATA has developed a turbulence sharing platform (IATA Turbulence Aware) to consolidate, standardize and enable access to worldwide real-time objective turbulence data collected from multiple airlines around the globe. The primary purpose of the IATA Turbulence Aware system, which became operational on 1 January 2020, is to provide airline pilots, dispatchers and operations center personnel with real-time, very detailed turbulence awareness. The platform supports a global industry shift toward data-driven turbulence mitigation.

Ultimately, the IATA Turbulence Aware platform provides an open solution to industry that will enable any operator to share their data within a global turbulence repository; the aim being that carriers will have access to each other's real-time turbulence data so that greater situational awareness, both preflight and in-flight, can be achieved.

The overall benefits of IATA's Met Project are to improve airline safety performance by decreasing turbulence-related injuries, optimizing fuel burn and gaining other operational efficiencies through more accurate flight planning based on improved forecast and real-time turbulence data.

The operational trial of IATA Turbulence Aware was conducted in 2019 with 35 airlines participating. Additionally, 15 integrators who provide a range of operational weather tools for dispatchers and pilots joined the initiative.

As at January 2020, 12 of the 35 airlines were sending real-time, in-situ, turbulence data to the platform from aircraft in flight. Approximately 45 million turbulence reports (smooth and turbulent) and will be generated from these airlines in the first year. Even more data is expected as more airlines adopt and implement the technology to send live reports to the platform.

The turbulence data is integrated into third-party vendor weather tools for operational use by airlines in the program. IATA also provides a Turbulence Aware Viewer tool, which may be used by dispatchers and in flight by pilots. The tool provides a visualization of real-time turbulence data over the previous four hours along with a long-term accessible archive. Post-flight analytics and manual historical data extraction are all possible via the viewer tool for post-flight analysis of turbulence, wind, temperature and in-flight turbulence safety events.

IATA's inaugural Turbulence Forum was held in Chicago in September 2019 and brought together over 70 representatives from industry with interests in turbulence data generation, operationalization and analytics.

Ground Operations Safety

Mission and Strategy

The IATA Ground Operations. mission is to improve safety, operational efficiency and foster a sustainable environment. Its strategy is to focus on the reduction of personal injuries, the cost of ground damage, delays and turnarounds, as well as $C0_2$ emissions and noise via global standardization and implementation of innovative solutions.

Injury and Damage Prevention

The injury and damage costs model has been finalized and will be incorporated into the IATA Incident Data Exchange (IDX). This will enable IATA to calculate the injury and damage costs at an industry level.

"Fall from height" and "unsafe driving" are repetitive incidents causing fatalities and severe injuries across the industry. Since there is a lack of data available across the industry, IATA has started working on a prevention program as well as promoting injury sharing and reporting. The injuries can be shared via Safety Alerts as well as reported via IDX.

Ground Operations Training Program

Attracting, developing and retaining talent is one of the biggest challenges of ground operations. A recent global study conducted by IATA estimated that there are approximately 135,000 employees worldwide that require continuous aviation training, and there will be 83,000 more employees required by 2022.

The three key themes uncovered by the study are:

- The 'tipping point' for employee retention is six months.
- Attracting talent is the biggest challenge faced by the aviation ground operations sector.
- The greatest competition for talent is not within the industry, but from other industries.

The full report can be accessed here.

To cope with increasing training needs while keeping costs in check, it is essential to make operations training more efficient and standardized across the industry. IATA has developed a standardized, globally applicable training program for ground operations based on the IATA Ground Operations Manual (IGOM), which was published as Chapter 11 of the Airport Handling Manual (AHM), Ed. 37, in 2017. The training program has since been further developed based on the updates to IGOM, IATA Operational Safety Audit (IOSA), IATA Safety Audit for Ground Operations (ISAGO) and AHM training requirements, mainly AHM 611, 590/1 and ISAGO/IOSA ORM and training charts. The scope is being kept equivalent to the IGOM scope covering front-line personnel up to supervisor duties in passenger handling, ramp handling and load control areas. The program has been recognized as a minimum training requirement and was included in the Standard Ground Handling Agreement (SGHA), effective as of 2023. IATA has developed the implementation toolkit, which is available in the electronic version of the AHM, Ed. 40, as well as a training implementation video, which can be viewed on the following link. IATA will also support members via regional campaigns.

AHM 908 Training for Ground Support Equipment (GSE) Maintenance has been completed and is published in the AHM to help keep GSE properly maintained and operationally safe.

IGOM Adoption Policy

The main aim of the IGOM Adoption Policy is to increase the level of standardization and harmonization of ground operations processes and procedures globally as well as to reduce risks in operations through commonly accepted "safe" procedures.

To ensure that the IGOM Adoption Policy is globally understood, accepted and implemented by the industry, IATA developed awareness videos highlighting:

- The IGOM Adoption Policy background

- Gap analysis between IATA IGOM and company GOM
- IGOM safety-critical procedures
- Assessment of company variation(s) to IGOM
- Risk assessment of company variation(s)

To view the videos, please follow this link and this one.

By end of 2019, IATA had also rolled out series of webinars to sensitize the industry on the IGOM Adoption Policy. IATA also supports the industry with the roll-out of IGOM adoption in their operations.

IGOM Implementation by Airports

Throughout 2019, IATA has collaborated with Heathrow Airport Limited to have IGOM accepted as a baseline for ramp operations at the airport. This is an important step toward positioning IGOM as the global recommended practice to safely perform ramp operations.

Connected, Ecological, Digital, Automated Ramp (CEDAR)

The CEDAR Project defines how advanced technology and data processing can be interlinked to deliver capacity improvements and enhanced processing of aircraft turnaround operations. The project aims to enhance three major areas on the ramp, namely digitalization of ramp services, GSE and aircraft stand design.

CEDAR is intended to contribute to the NEXTT and Airport Collaborative Decision Making (ACDM) initiatives with the aim of addressing the ground operations portion and is aligned with the Ground Operations Group (GOG) strategic objectives, which are:

- Improve the efficiency of ground operations through standardization and technology
- Reduce the environmental impact of ground operations

The main benefit provided to members is enhanced safety and efficiency, which is enabled by:

- Identifying relevant real-time operational data from multiple sources, collating it and sharing it in a way that will facilitate and support critical data-driven operational decisions.
- Facilitating and driving day-to-day operational decisions based on real-time information, such as equipment and personnel allocation to flights based on specific aircraft type/load quantity/passengers.
- Utilizing data records to analyze trends to optimize resource deployment and facilitate assessment of equipment purchases.
- Reducing ramp vehicle congestion, aircraft and equipment fuel consumption and emissions by optimizing vehicle sizes and movements.
- Improving airlines', airports' and ground handlers' quality of operations and share the benefit of the various investments to best fit and cater to future demand.

Ground Support Equipment

Enhanced GSE can be a positive contributor to improved safety – for staff, passengers and aircraft. GSE fitted with proximity sensing and warning systems is already well established – major manufacturers report that at least 80% of the units they now sell are equipped with these systems – and the trend is increasing. IATA is working on a model for refining and defining the tangible benefits of using "enhanced GSE". With this in place, we hope to be able to demonstrate to industry the practical advantages and benefits of using the latest GSE technology and promote its global implementation.

GSE manufacturers are also working on self-docking GSE with several types of equipment well advanced with prototypes and trials or even in service. The next expected advancement is in the field of autonomous vehicles on the ramp and already there are prototypes in use. Also under investigation are ways of improving the air quality delivered to the aircraft cabin while the aircraft is on the ground as well as built-in fire suppression systems on GSE that would prevent injuries and/or damage if the GSE catches fire.

Being environmentally aware is a top priority in the airline industry and GSE again has a role to play. Electrically powered GSE are often selected when it comes time to replace equipment and AHM 907 Basic Requirements for Electrically Powered GSE (e-GSE) provides guidelines for taking this step toward a cleaner and quieter ramp environment.

IATA is working on developing a model to establish a baseline of current GSE exhaust emissions and noise levels with the aim of being able to quantify the benefits of switching to "greener" GSE. Regarding future developments, IATA is looking into ways in which GSE can be better integrated into the overall digitization initiative and form a seamless link in the "connected ramp".

Fatigue Management

Fatigue continues to be a contributory factor in many accidents and incidents, and continues to be an identified risk on individual operators' hazard registries. It is a hazard that predictably degrades human performance, yet is unavoidable in aviation operations because the human brain and body function optimally with unrestricted sleep at night. As such, fatigue cannot be eliminated, but it must be managed.

The IATA Fatigue Management Task Force (FMTF) has been established to develop tools and guidance to provide operators the means to identify and manage efficiently the safety risks related to fatigue across all aviation disciplines. The FMTF aims to realize the operational benefits associated with fatigue management implementation. These are widely available for all and can be found on the IATA Fatigue Management website.

Much of 2019 was focused on assuring a common understanding between the prescriptive fatigue management approach and a Fatigue Risk Management System (FRMS). Industry is encouraged to utilize a tiered approach for performance-based fatigue management, that has been developed in coordination with the IATA Fatigue Aware initiative.

ICAO, the International Federation of Air Line Pilots' Association (IFALPA), as well as human factor experts and sleep scientists from around the world are engaged in the Fatigue Aware initiative to develop a set of tools to systematically collect and collate all information about crew fatigue and fatigue-related performance, as well as the factors affecting them, so it may be analyzed and compared across the industry. The goal is to enable data-driven decisions to manage fatigue risk.

The focus will continue in 2020, with the FMTF stressing the need for States and operators to implement fatigue management programs that are within the prescriptive approach, as it is agreed most are not ready to effectively and efficiently implement an FRMS.

ENHANCE QUALITY AND COMPLIANCE

Regulations must evolve as the industry grows and technologies change. The IATA audit programs aim to increase global safety performance and reduce the number of redundant auditing activities in the industry.

IATA Operational Safety Audit

As an internationally recognized evaluation system designed to assess the operational management and control systems of an airline, the IATA Operational Safety Audit (IOSA) program continues to be acknowledged by numerous regulators and is utilized to complement their oversight activities. In 2019, regulators, including, but not limited to, the German Luftfahrt-Bundesamt, the Civil Aviation Authority of Singapore, the Hong Kong Civil Aviation Department and more, signed the Memorandum of Understanding (MoU) with IATA on the use of the IOSA program.

As at 18 December 2019, there were 438 airlines on the IOSA registry, including 141 non-IATA members. Having non-IATA members on the registry and the exchange of almost 2,000 IOSA Audit Reports every year confirms the participation of the airlines in the IOSA program.

In June 2019, IATA introduced a new methodology under which the effectiveness of implementing an IOSA requirement will be audited. The method is based on the SMS Evaluation Tool developed by the Safety Management International Collaboration Group (SM ICG), which comprises authorities such as the FAA, European Aviation Safety Agency (EASA), Transport Canada, National Civil Aviation Agency of Brazil (ANAC) and the Australian Civil Aviation Safety Authority (CASA) with ICAO as an observer.

IOSA and the IATA Safety Audit for Ground Operations (ISAGO) are undergoing a digital transformation. The digital transformation aims to meet the changing needs of the airline industry, respond to the increasing involvement of regulatory bodies, and address additional program complexity. The transformation plans to establish a collaboration platform that connects airlines, regulators, IATA and other stakeholders with the purpose of sharing information. Further information can be found here.

Among others, IATA is working on the following changes to the program in the coming years:

- Further refining the method of assessing the effectiveness of standards implementation
- Continuous improvement of IOSA auditor training
- Integrated risk framework

IATA Standard Safety Assessment Program

The IATA Standard Safety Assessment Program (ISSA) is an evaluation program created primarily for airlines that operate aircraft with a maximum takeoff weight (MTOW) below 5,700 kg. ISSA builds on IATA's internationally recognized IOSA program, assessing documentation and implementation of each requirement. Assessment standards are derived directly from IOSA Standards and Recommended Practices, including elements of the ICAO SMS. ISSA assessments are performed by IATA-accredited Audit Organizations.

Following an in-depth review of the ISSA program, improvements were implemented in 2019 to make it more effective and suitable for the airline industry:

- Reduced price of assessment
- Extension of scope to allow airlines operating both aircraft with a maximum takeoff weight below 5,700 kg as well as aircraft with a maximum takeoff weight over 5,700 kg to stay in the ISSA registry.
- Revised ISSA standards and recommended practices to add some more safety-critical requirements that are important elements in code-share oversight.

Furthermore, in 2019:

- The ISSA Standards Manual now meets all ICAO SMS-related requirements.
- IATA entered a collaboration with the Latin American and Caribbean Air Transport Association (ALTA), in which ALTA promotes ISSA with IATA in the Latin America and Caribbean region. The collaboration with ALTA proved very successful. To date, it has led to 16 assessments from the LATAM region.
- Likewise, collaborations were entered with the African Airline Association (AFRAA) and the Airline Transport Association of Canada (ATAC), respectively.
- There are currently 11 ISSA-registered airlines on the registry and one airline is in the process of closing its assessment. This airline will soon be included on the ISSA registry. In addition, 12 more assessments are expected in 2020.

Further information can be found at www.iata.org/issa

IATA Safety Audit for Ground Operations

ISAGO is a standardized and structured audit program of Ground Service Providers (GSPs) operating at airports. The audits assess a GSP's conformance with standards developed by global industry experts for the management, oversight and implementation of ground operations. The standards aim to improve flight safety and reduce ramp accidents and incidents through safety management and standardization of procedures. The audits are conducted by highly trained and experienced auditors who are members of the IATA Charter of Professional Auditors (CoPA).

ISAGO is currently the only global program that is aligned with ICAO Doc 10121, Manual on Ground Handling, and requires a GSP to implement a SMS equal to that of aircraft and airport operators.

Analysis of data submitted to the IATA Ground Damage Database (GDDB) indicated (with clear and strong statistical evidence) that ISAGO made a positive impact on the safety culture and performance of the GSPs that had been audited and granted an ISAGO registration. These GSPs exhibited a significantly better safety reporting culture, in that their employees were twice as likely to report damage compared to employees of a non-ISAGO GSP. The damage was also less severe.

In just over a decade, ISAGO has grown and now reaches every region of the world. At the time of writing, we have nearly 180 GSPs that are ISAGO-registered, operating at nearly 200 airports worldwide. They include large GSPs that are truly multi-national and global as well as single airport operators. The ground handling business is not easy; contracts change frequently and are particularly price-sensitive. But, we have every confidence that a GSP that has ISAGO registration is fully equipped to meet the safety demands of airlines, airports and the flying public. We also have every confidence in ISAGO meeting the needs of States, guided by ICAO, should they desire greater oversight of ground operations.

IATA Fuel Quality Pool

The IATA Fuel Quality Pool (IFQP) is a group of nearly 200 airlines that work together to assess the implementation of safety and quality standards and procedures at aviation fuel facilities. The IFQP does not set standards, but ensures fuel quality policies and standards are followed, and major fuel safety items are addressed, such as compliance with the use of differential pressure-limiting devices on all monitor-equipped vehicles.

IFQP-qualified inspectors perform inspections against industry regulations at airports worldwide and the reports are shared among IFQP members.

By providing comprehensive training of inspectors and development of standardized inspection procedures according to airline and regulatory requirements, the IFQP enhances safety and improves quality control standards of fuel facilities at the airport.

De/Anti-icing Quality Control Pool

The IATA De/Anti-icing Quality Control Pool (DAQCP) is a group of more than 130 airlines that audit de/anti-icing providers and share the inspection reports and workload at various locations worldwide. The pool's main goal is to ensure that deicing/anti-icing safety guidelines, quality control recommendations, standards and procedures are followed at all airports.

IATA Drinking Water Quality Pool

The IATA Drinking Water Quality Pool (IDQP) was created by a number of airlines to safeguard the health of passengers and crew onboard aircraft by using the highest standards to ensure water quality. By sharing inspection reports, airlines avoid multiple audits of the same provider at the same location, thereby enjoying substantial financial savings from reductions of airport inspection workloads and associated costs.

ADVOCATE FOR IMPROVED AVIATION INFRASTRUCTURE

Airline operators are heavily investing in fleet and network expansion and on-board avionics. Regions across the world are experiencing double digit traffic growth and are faced with bottlenecks and lack of appropriate infrastructure to cope with the growth. The regulatory framework and Air Traffic Management (ATM) capabilities must evolve in a harmonized context and meet the pace of advancing technologies. The industry also needs to ensure that new entrants and airspace users are safely and efficiently integrated into airspace.

It is important for IATA and the aviation industry to move toward a future vision of ATM and look at the ATM system gate-to-gate. Key drivers for change and operational improvements are safety, efficiency and cost-effectiveness. Within that context, IATA is working with member airlines, key partners such as ICAO, Civil Air Navigation Services Organization (CANSO), State regulators and Air Navigation Service Providers (ANSPs), to ensure that ATM operations and infrastructure improve the level of safety, enhance efficiency, reduce CO_2 emissions, and are supported by a positive cost-benefit analysis.

Global Navigation Satellite Systems Interference

Since the last IATA Safety Report, IATA has received an increasing number of reports of harmful interference to Global Navigation Satellite Systems (GNSS), some of which have concerning implications to flight safety. As GNSS is now a necessary cornerstone of daily flight and ATM operations, effective mitigations of harmful interference will ensure that the benefits of safe GNSS-based operations can continue. IATA, in cooperation with International Federation of Air Traffic Controllers (IFATCA) and IFALPA has raised awareness of this safety-critical issue to the 40th ICAO Assembly. IATA recommended States and ICAO ensure that appropriate frequency regulations are in place to protect allocated GNSS frequencies and that contingency procedures and essential conventional navigation infrastructure are retained. The ICAO Assembly expressed its strong support of these recommendations and has requested the ICAO Council to act on them as an urgent ICAO priority. In addition to ICAO, this issue of harmful interference to GNSS has been brought to the attention of and for actions by the International Telecommunication Union (ITU), the United Nations Specialized Agency for information and communication technologies and the global authority on radio spectrum protections.

Space Launches and Commercial Space Operations

As commercial space activities continue to evolve, IATA is concerned by the suggestion that these operations should be kept free of provision development. Although IATA understands there is a desire to limit development of global provisions that may constrain industry innovations, these activities will include low orbit operations and recoverable vehicles that will transit operational airspace. In addition, the manner in which these operations may be integrated into civil operations may be similar to Unmanned Traffic Management (UTM) developments. The goal should be to develop provisions and best practices that will permit the integration of these operations into current civil operations.

Unauthorized Use of Unmanned Vehicles

With the increasing use of Unmanned Aircraft Systems (UAS) for personal and recreational use, there has been an increase in the number of sightings of unauthorized UAS in close proximity to commercial aircraft and airports. Some of these sightings have resulted in extensive disruption to airline and airport operations, with a large impact on the travelling public. The unauthorized operation of UAS by individuals in the vicinity of airports is similar to an unauthorized manned aircraft in the vicinity of an airport, and in neither case has the aircraft been approved for the operation. However, unauthorized users of UAS cannot easily be identified, tracked, and excluded from the airspace where they pose the greatest safety and security threat to civil aviation.

Counter-UAS technology to support detection is still in the development stage and has its own limitations. Therefore, a comprehensive approach to detection, mitigation and recovery of unauthorized UAS is needed. Counter-UAS measures should not create unintended safety hazards and unmitigated risks to air transport aircraft, authorized UAS operators, and aviation infrastructure and personnel. Therefore, a comprehensive risk assessment needs to be conducted prior to adopting a strategy for counter-UAS measures or technologies. Particularly, there needs to be clearly defined processes for responding to and handling unauthorized or reckless use of UAS in close proximity to aircraft and airports.

IATA continues to work with industry partners to ensure awareness of the safety risks resulting from the operation of small UAS (drones) close to aircraft and airports. All material produced under this campaign can be accessed on the IATA website. In addition, IATA, along with other international organizations, presented a paper to the 40th Session of the ICAO Assembly inviting ICAO and States to recognize a mechanism by which industry would develop high-level standards and guidance, building on existing standards and the work of ICAO groups, to establish a harmonized process for initiating detection and countermeasures of these incidents.

Unmanned Traffic Management and Space Traffic Management

The pace at which the UAS industry is growing is unprecedented. There are already plans in motion for urban air mobility, the transport of cargo over the last to medium mile, cross-border operations, and connecting multiple cities. With such high growth rates, it is critical to find the balance between developing safety standards and innovation. One of IATA's main concerns is that trials will proceed without the necessary safeguards and standards in place. While much can be learned from these trials, safety also needs to be ensured, because it is critical for both commercial aviation and unmanned airspace users. Pursuant to the 40th Session of the ICAO Assembly, IATA is working with the manned and unmanned industries to develop provisions, and provide input to ICAO, for the safe and efficient integration of UAS into aviation.

SUPPORT CONSISTENT IMPLEMENTATION OF SAFETY MANAGEMENT SYSTEMS

In 2019, IATA continued its focus on driving effectiveness from the Safety Management System (SMS) elements that have been put in place, while continuing to emphasize that operators should have the autonomy to develop their own SMS programs in the context of their organization to achieve the intent. Numerous initiatives throughout the year have contributed to this overall goal.

Safety Information Exchange and Protection

The importance of safety data and safety information to maintain and improve aviation safety is widely recognized. SMS or any other performance-based decision-making management system cannot exist without appropriate and robust data and information feeding into it.

As a result, IATA is creating a framework that ensures safety information exchange initiatives, such as State/Industry Collaborative Safety Teams as a means to support State Safety Programs. The framework is based on principles that include the proper use of the safety information and protections aligned with ICAO Annex 19 provisions that became applicable in November 2019.

IATA has consistently promoted State/Industry partnership and collaboration as critical to setting and achieving sustainable and effective safety goals, as intended through SMS programs. This message was conveyed at ICAO's 40th Assembly with a working paper jointly presented by IATA, Singapore and the United States and co-sponsored by China, Indonesia, the Philippines, the United Kingdom and the Flight Safety Foundation. This paper and the Assembly's acceptance of it further solidified IATA's position. IATA will continue to advocate for this concept as well as other initiatives that serve to protect service provider safety data and safety information, to ensure its continued availability to support safety management activities for all.

Safety Culture – A Key Enabler of Safety Management

The first amendment to ICAO Annex 19 recommends the development of a positive safety culture to support the SMS programs that are now compulsory across aviation. Having an SMS in place, however, is not enough to ensure safe operations. The organizational culture and how it influences employees' behavior is a critical enabler to manage safety effectively.

IATA strongly believes in, and continues to raise awareness about, the key role safety culture plays in building an effective SMS, with a focus on the impact of a just culture on incident and hazard reporting and, therefore, on proactive safety management.

In support of advocacy efforts on safety culture, in 2017, IATA developed the Aviation Safety Culture (I-ASC) survey. The survey has proved to be a valuable tool in helping gain insights into potential safety hazards through confidential and aggregated quantitative and qualitative data collected directly from frontline staff from over 40 airlines.

With expanded participation, the I-ASC survey now provides organizations with valuable benchmarking capabilities to better understand their own safety culture, as well as provides IATA the means to develop best practice guidelines in safety culture improvement.

Building on its experience with the airline community, IATA has begun working with airports and is planning to extend its collaboration to ground service providers, supporting improvements and a harmonized approach to safety culture across the industry. Additionally, more capabilities are planned to support organizations in measuring and improving their safety culture to increase the effectiveness of their SMS program and support initiatives.

IATA Safety Issue Review Meeting

The IATA Safety Issue Review Meeting (SIRM) is a biannual meeting held each year in the spring and fall. Twenty-seven of these meetings have taken place to date, making the SIRM one of IATA Safety's longest running meetings.

SIRM's success is predicated on providing an environment where participants feel comfortable sharing their events, issues and solutions with their fellow safety professionals. This multi-organizational collaboration has proven to be an effective means to leverage continuous improvement, and is an originator to the emerging global information-sharing initiatives that are expected to grow significantly, albeit in a controlled and appropriate manner.

Recognizing that not all interested parties can attend every meeting, and for the broader aviation community, IATA produces a bulletin that provides a summarized deidentified recap of the hazards and lessons learned. Further information on upcoming SIRMs and the latest bulletins can be found here.

SUPPORT EFFECTIVE TRAINING

Training and Licensing

The IATA Training and Licensing portfolio is a multifaceted portfolio that seeks to improve safety through enhanced pilot training and qualification.

Working with the IATA Pilot Training Task Force, IATA participates in the development of new standards and publishes guidance materials and best practices to support operators and training organizations in implementing these standards. Additionally, IATA offers consultancy services to provide practical support for the implementation of Competency-based Training and Assessment (CBTA) programs, including Evidence-based Training (EBT). IATA supports a consistent approach to flight crew training, from the selection process through initial licensing training and operator training, by promoting CBTA programs. Contact us for more information.

IATA is committed to the Total Systems Approach (TSA), which stands for the application of CBTA across all aviation disciplines in general, and, in particular, to a pilot's entire career. Hence, the defined competencies for pilots and instructors/evaluators should be consistently applied throughout pilot aptitude testing, initial (ab initio) training, type rating training and testing, command upgrade, recurrent training (including EBT), as well as instructor and examiner selection and training. IATA also addresses specific areas of training, such as Upset Prevention and Recovery Training (UPRT) and flight crew monitoring, by publishing guidance materials.

Pilot Aptitude Testing

Designed to support aviation managers in the field of pilot selection, Pilot Aptitude Testing (PAT) is a structured, science-based candidate selection process. Proven to be highly effective and efficient, PAT provides enhanced safety, lower overall training costs, higher success rates in training and operations performance, a more positive working environment, and reductions in labor turnover. This becomes particularly important in view of the forecast increased demand for qualified pilots in the coming decades.

The 3rd Edition of the IATA PAT Manual integrates the pilot competencies framework into the testing process.

Competency-based Training and Assessment for Pilots

IATA has supported the revision of the provisions of Annex 1 - Personnel Licensing, the Procedures for Air Navigation Services - Training (PANS-TRG Doc 9868) and Annex 6 Part 1, as well as the consequential amendments of related guidance materials, including the Manual of Evidence-based Training (Doc 9995) and the Manual on Upset Prevention and Recovery Training (Doc 10011).

These amendments promote the expansion of a harmonized pilot competency set and clarify the role of the competencies in the Threat and Error Management (TEM) model. The competencies of the approved adapted competency model provide the individual and team countermeasures to threats, errors and undesired aircraft states.

Furthermore, IATA supports the global implementation of CBTA by leading the drafting of an ICAO CBTA implementation guide. The targeted audience for this guidance material is training organizations, operators and civil aviation authorities (CAAs) wishing to develop and implement a CBTA program. This guidance addresses the key elements to be considered by an organization that wants to put in place the CBTA principles (i.e., transitioning from traditional training to CBTA, training system performance, oversight). The targeted publication date for this guide is 2020.

Competency-based Training and Assessment for Instructors and Evaluators

Given the essential contribution of instructors and evaluators (IEs) to flight safety, IATA considers it important to enhance the level of competency of IEs globally. Therefore, the 1st Edition of the IATA Guidance Material for Instructor and Evaluator Training introduces and defines a set of IE competencies to be applied, from the selection process across all types of IE training, from licensing to operator recurrent training, by both operators and training organizations. The IATA IE competency set has been endorsed by ICAO.

Multi-Crew Pilot License

Progress in the design and reliability of modern aircraft, a rapidly changing operational environment, and the need to better address the human factors issue prompted an industry review of pilot training. The traditional hours-based qualification process fails to guarantee competency in all cases. Therefore, the industry saw a need to develop a new paradigm for CBTA of airline pilots: Multi-Crew Pilot License (MPL) training.

MPL was the first license to move from task-based to CBTA in a multi-crew setting from the initial stages of training.

The 2nd Edition of the co-branded IATA/IFALPA MPL Implementation Guide was published in 2015 to support airlines during their implementation process.

Evidence-based Training

Evidence-based Training (EBT) was the first recurrent training program to apply the principles of CBTA for safe, effective and efficient airline operations, while addressing relevant threats.

The aim of an EBT program is to identify, develop and evaluate the key competencies required by pilots to operate safely, effectively and efficiently in a commercial air transport environment, by managing the most relevant threats and errors, based on evidence collected in operations and training. The following documents published by ICAO and IATA allow airlines to develop an effective EBT program:

- ICAO Manual of Evidence-based Training (Doc.9995)
- Updates to ICAO Procedures for Air Navigation Services - Training (PANS-TRG, Doc 9868)
- IATA/ICAO/IFALPA Evidence-based Training Implementation Guide
- IATA Data Report for Evidence-based Training

IATA is currently reviewing the 1st Edition of the Data Report for EBT. Publication of the 2nd Edition is expected by the end of 2020.

Upset Prevention and Recovery Training

Loss of Control – In-flight is one of the leading causes of fatalities in commercial aviation. This has led to a revision of current training practices and the adoption of new regulations to address this phenomenon. The IATA Guidance Material and Best Practices for the Implementation of UPRT manual was first published in 2015 and updated in January 2019 (2nd Ed.). The manual serves as guidance material for operators to develop an UPRT program as part of their recurrent training. It can also be considered when including UPRT into other programs, such as conversion, upgrading and type rating training. The document specifically focuses on practical guidance for UPRT instructor training. It also includes recommendations for operators cooperating with Approved Training Organizations (ATOs) providing licensing training for their *ab-initio* cadets. It may be used for both traditional and CBT schemes.

Flight Crew Monitoring

The need to address flight crew monitoring arose from an aviation community consensus around the importance of enhancing monitoring skills, based on data analysis from various sources. The IATA Guidance Material for Improving Flight Crew Monitoring, published in 2016, provides practical guidance for operators and ATOs for the development of flight crew monitoring training. It also highlights how monitoring is embedded in all pilot competencies and how these competencies serve as countermeasures in the TEM model.

Note: All IATA guidance materials produced under Training and Licensing mentioned above are available for free download from our website.

Competency-based Training and Assessment for Technicians

IATA is part of the ICAO Competency-based Training and Assessment Task Force (CBTA-TF) for Maintenance, whose task consists of developing an ICAO framework for technician training.

IATA has supported the revision of the provisions of the Procedures for Air Navigation Services - Training (PANS-TRG Doc 9868) Part III Training and Assessment for Aircraft Maintenance Personnel.

The aim of a CBTA program for technicians is to identify, develop and evaluate the competencies required by commercial aircraft maintenance personnel to operate safely, effectively and efficiently. CBTA in maintenance is geared toward individual student performance. The specification of the competency to be achieved, the evaluation of the student's entry level, the selection of the appropriate training method and training aids, and the assessment of a student's performance are the key factors to the success of such a program.

IDENTIFY AND ADDRESS EMERGING/ EVOLVING SAFETY ISSUES

Since SMS relies on data to identify emerging risks, IATA is putting additional effort to improve not only industry access to data, but also its capability for automation for more efficient safety analyses.

This section provides key highlights and developments for emerging/evolving operational risks that have recently generated remarkable activity and media attention.

Cargo Safety and Lithium Batteries

The ICAO Flight Operations Panel Cargo Safety Sub-Group (FLTOPSP-CSSG) was tasked to develop revisions to Annex 6 – Flight Operations, and associated guidance material, to address the safe carriage of cargo, mail and baggage in aircraft cargo compartments. The FLTOPS-CSSG completed its work in 2019 and has now been disbanded.

The FLTOPS-CSSG completed development of a new Chapter 15 – Cargo Compartment Safety for Annex 6 – Operation of Aircraft, Part I, International Commercial Air Transport – Aeroplanes in 2018. Chapter 15 to Annex 6 was sent out by State Letter in August 2018. There were minimal comments from member States or nongovernmental organizations and the final version of Chapter 15, with other changes to Annex 6, is now waiting for formal adoption by the ICAO Council and will become effective 5 November 2020.

In 2019, the FLTOPSP-CSSG completed work on guidance material to support Chapter 15. The guidance material will be published as a new ICAO Manual, Doc 10102, Guidance for Safe Operations Involving Aeroplane Cargo Compartments. This guidance document is currently being reviewed by the ICAO Secretariat and is expected to be published in early 2020 to support the November 2020 adoption of the changes to Annex 6.

The SAE Aerospace G-27 Committee, which was established at the request of ICAO, continues its work to develop a performance standard that can be used to test packages containing lithium batteries. The objective of the standard is to qualify packaging for lithium batteries that, in the event of a thermal runaway of a lithium cell within the package, there would be no hazardous effects outside the package.

The SAE G-27 Committee convened through conference calls and physical meetings during 2019 to progress the development of the performance standard. A representative from IATA Cargo is one of the members of the G-27 Committee.

At the time of writing, it is expected that the G-27 Committee will not complete its work before the end of 2020. Once the committee is satisfied with the draft standard, it will then be sent out to the G-27 committee for ballot. If the committee votes to adopt the standard, it will then be submitted to SAE for final approval. Once SAE publishes the final standard, it will then be considered by the applicable ICAO bodies, likely the Dangerous Goods Panel, Flight Operations Panel and Airworthiness Panel, to determine if the standard is suitable for adoption into the ICAO Technical Instructions.

IATA Cargo implemented a reporting and alert system in October 2019 to provide a mechanism for airlines to advise IATA of incidents involving undeclared and mis-declared dangerous goods in cargo, and for the airlines that have signed up to the alert system to be provided with information on the incident so they can take appropriate action in accordance with their safety risk assessment.

IATA Cargo continues to promote outreach to industry on dangerous goods and the need for compliance with the Dangerous Goods Regulations. In 2019, there were a total of eight one-day dangerous goods workshops conducted, two in Africa in February and six in Asia in November. This was in addition to the 9th annual two-day Lithium Battery Workshop that was held in Amsterdam in October 2019.

SECURITY

Aviation Cyber Security

Aviation Cyber Security (ACS) is a key priority for airlines and the broader industry, particularly given the backdrop of increased digitization and connectivity that is helping to transform approaches to customer experiences, aviation operations, delivery by service providers, and regulatory oversight, to name a few. Technology and digitization not only bring many advantages, but also risks associated with the challenge of finding and managing cyber vulnerabilities across complex, international operations from airports, aircraft operators, ATM, and supply chain. This complexity makes the aviation sector globally interdependent and vulnerable to hidden risks and ever-increasing threats.

It should be expected that, like today, adversaries will continue their efforts to exploit vulnerabilities in systems for financial, reputational, and mass disruption gains. Cyber risks and the need to proactively identify vulnerabilities only increases with more digitization and connectivity. Notwithstanding this, the threat of cyberterrorism in the aviation industry remains assessed as low[1]. Nevertheless, that continuous improvement of the measures we know today is needed to strategically safeguard the industry against new types of risk tomorrow.

The 40th Session of the ICAO Assembly in 2019 called on States and the industry to take further action to counter cyberthreats to civil aviation through ICAO and called on ICAO to develop a cybersecurity action plan to support States in the adoption of the ICAO Aviation Cyber Security Strategy and to continue to ensure that cybersecurity matters are considered in a coordinated manner. IATA strongly supports the position of ICAO as the most appropriate organization to drive coherent global dialogue and action on ACS. IATA is working with the ICAO Secretariat Study Group on Cybersecurity (SSGC) and Trust Framework Study Group (TFSG) to develop the cybersecurity action plan called for by the Assembly. Through its involvement in the development of this action plan, IATA can advocate for the incorporation of key elements of the proposed industry-led cybersecurity high-level work plan and to ensure that both are aligned.

1 Defined by the ICAO Aviation Security Global Risk Context Statement, Second Edition, 2019 (Doc 10108) as a theoretically plausible scenario, but with no examples or signs of attack or attack planning, and with a theoretical intent, but no apparent capability.

In order to support the industry in addressing this ever-evolving threat, IATA is developing an industry-wide Aviation Cyber Security Strategy. Since June 2019, this work is guided by the Security Advisory Council (SAC) that advises IATA, in collaboration with the Digital Transformation Advisory Council (DTAC), to answer the cybersecurity challenges faced by IATA and the airline industry. Furthermore, through the continuous work of the Aircraft Cyber Security Task Force (ACSTF), IATA addresses airline concerns related to understanding and managing cyberthreats and risks concerning the safety of flight. Another critical component of this strategy is the annual Aviation Cyber Security Roundtable (ACSR). The inaugural two-day event was held in April 2019 as part of a broader, cross-sector engagement effort on ACS. The ACSR gathers industry stakeholders to work toward a 2030 vision for a coordinated approach to ACS.

By taking actions on ACS, IATA is in a unique position to systemically reduce cyber risk for its members across the globe and secure the continued safe growth of air transport by developing a global cybersecurity framework as well as advocating for relevant standards in this matter.

Regulatory Evolution of ICAO Annex 17

ICAO Annex 17 has been amended six times during the past decade (2010-2019) and now contains 29 definitions, 24 recommended practices and 95 standards with Amendment 17, which will become applicable in July 2020. This represents an overall enhancement to the aviation security global baseline and aims to provide strategic safeguards for industry growth.

The latest amendment contains new provisions on information sharing between States and stakeholders for better:

- Risk assessments
- Vulnerability assessments
- Background checks
- Enhanced access controls
- Staff screening
- Explosive detection capabilities for passengers and staff
- Landside security
- Cybersecurity
- Man-Portable Air Defense Systems (MANPADS)
- Security measures for cabin and checked baggage, cargo, mail and other goods
- Training and certification
- Oversight of subcontractors

These have been introduced by the Aviation Security (AVSEC) Panel and approved by the ICAO Council since 2010.

IATA is actively contributing to the development of new security provisions, as well as the continuous enhancement of Annex 17, for better implementation by States, and more importantly, for reinforcing the global security baseline that is essential for the safe and healthy growth of air traffic for the years to come.

Since 2002, the ICAO Universal Security Audit Program (USAP) uses Annex 17 Standards for its oversight, and the global level of implementation by States remains at approximately 70%. Unfortunately, this situation creates opportunities for additional measures imposed by some States on airline operators, and therefore, the effective, sustainable, risk-based and harmonized implementation of all standards contained in Annex 17 remains an IATA target for 2020-2022.

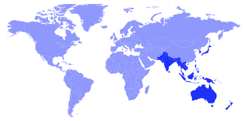
Conflict Zones

Safety and security risks associated with conflict zones continue to be major concerns for aircraft operators. The tragic events in Iran in January 2020 underscore the imperative that airlines require access to relevant and corroborated information from governments to be able to perform accurate risk assessments. ICAO Annex 6, 15 and 17 have been amended following the outcomes of the Dutch Safety Board investigation into MH17. Accordingly, IATA's own IOSA program standards and recommended practices continue to evolve.

IATA and its member airlines continue to participate in various multilateral forums such as the EU Integrated Aviation Security Risk Group, whose results inform the EASA conflict zone information bulletins. Additionally, IATA is in the final steps of a pilot development to provide member airlines with a tool that aims to collate a range of open source information to help direct and prioritize airline risk assessments.

REGIONAL INSIGHT

Asia-Pacific Region (ASPAC)



SFO ASPAC Safety Strategy

Safety and Flight Operations (SFO) ASPAC has developed and continues to implement a risk-based, data-driven safety strategy with reactive, proactive and predictive capabilities that focuses on the top regional fatal accident risks:

- Approach and Landing Accidents (ALAR)
- Loss of Control – In-flight (LOC-I)
- Controlled Flight into Terrain (CFIT)

We have also focused on the emerging Mid-Air Collision (MAC) risk using TCAS RA information from Flight Data Exchange (FDX) and other sources like ICAO Large Height Deviations.

SFO ASPAC used GADM as a foundational tool for safety analysis, decision-making, and performance monitoring when working with ICAO, individual States, airline members and other system stakeholders. GADM enables data-driven risk identification and performance monitoring.

SFO ASPAC also liaises and collaborates with key partners like the Association of Asia Pacific Airlines (AAPA) and the US Commercial Aviation Safety Team (CAST) on select safety initiatives.

Reactive: with ICAO at Asia-Pacific Regional Aviation Safety Team

The annual IATA Safety Report is one of the sources of information used to produce the annual Asia-Pacific Safety Report, which is, in turn, used to focus regional initiatives on the top risks. The Asia-Pacific Regional Aviation Safety Team (APRAST) continues to develop Safety Enhancement Initiatives (SEIs) pertinent to the top three risk areas and encourage their implementation. In 2019, APRAST developed an online tracking tool to monitor SEI implementation for States and industry.

IATA SFO ASPAC served as the industry co-chair of APRAST, with China as the States' co-chair.

Proactive: Asia-Pacific Information Sharing Demonstration Project

The Asia-Pacific Information Sharing Demonstration Project is an APRAST initiative with a governance board co-chaired by Singapore and IATA. The project finalized a MAC risk analysis on routes approaching and departing airports at participating States and developed recommended mitigations. The project also initiated ALAR and Go Around risk analysis for airports at the five member States.

Participating States are Singapore, Japan, China, Indonesia and the Philippines. Japan Airlines, ANA, the Lion Group, Singapore Airlines and Scoot are some of the participating airlines.

Predictive: Global Safety Predictive Analytics Research Center (SPARC) in Singapore

In 2015, IATA and the Civil Aviation Authority of Singapore (CAAS) jointly initiated a feasibility study for the application of predictive analytics on aircraft data. The technical feasibility of the project was validated during 2016 and 2017. During 2018, three runway-related machine learning algorithms were developed. In 2019, the algorithms were tested, finalized, and shared with the Commercial Aviation Safety Team (CAST) and Aviation Safety Information and Sharing System (ASIAS) during an information sharing meeting.

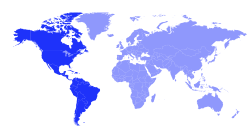
The algorithms enable the model to learn from egregious approaches the key feature(s) that would influence the risk of a runway excursion for landing aircraft. In each case, the analysis from applying the algorithms has identified primary causal features of an event and associated confidence levels in the model's prediction of their ongoing effect. While the predictive results varied depending on the prediction point, this predictive confidence exceeded 90% in some cases. It is expected that, as the algorithms are trained using larger volumes of data, their predictive power will improve.

Enhance Quality and Compliance

SFO ASPAC organized a joint ICAO/IATA ISAGO workshop at the ICAO regional office in Bangkok. Attendance included more than 90 participants from States and airports.

SFO ASPAC continues to promote IOSA with airlines in ASPAC and its adoption as an additional means of oversight by States. There were 69 airlines from the region in the IOSA registry at year end.

Pan-America Region



The Americas SFO region continued efforts to reduce fatality risk with a focus on developing and implementing a risk-based, data-driven approach that is proactive in identifying/mitigating existing risk and preventing future risk through enhanced collaboration with all stakeholders.

In facilitating safety and efficiency improvements for the region, the Regional Coordinating Group (RCG) of IATA is utilizing a data-driving approach to enable the strategic and tactical implementation of Collaborative Safety Teams (CST), among other initiatives with States to achieve continuous improvement of safety levels within each country.

North Atlantic and North America

The safety performance in the North Atlantic (NAT) High-Level Airspace (HLA), as measured and monitored by the NAT Systems Planning Group (SPG) for 2018, showed that over 58% of the key performance indicators (KPIs) were met as a decreasing trend was observed in comparison to the previous three-year period's performance. It is noted, that in the vertical plane, incorporating the estimated benefits of the Strategic Lateral Offset Procedure (SLOP) reduces the vertical collision risk. In the lateral plane, the practice of requiring position reporting of "NEXT and NEXT +1" and of requiring the "Confirm Assigned Route" Controller Pilot Data Link Communication (CPDLC) message sets proved beneficial in reducing risk. The proactive management of risk through identification and control of existing or emerging safety issues in the NAT and North American (NAM) regions continues in collaboration with several stakeholders such as the US CAST to reduce risk system-wide with a data-driven approach.

Latin America and Caribbean

Safety performance in the Latin American and Caribbean (LATAM/CAR) region continues to focus on fatality risk reduction considering the top four areas of risk (Controlled Flight into-Terrain, Mid-Air Collision, Loss of Control – In-flight and Runway Excursion) aligned with the goals of reducing fatalities by 50% in 2020 based on 2010 statistics. The Regional Aviation Safety Group – Pan American (RASG-PA) notes that fatality risk is trending in the right direction, but the region's risk footprint is changing. Hence, the RASG-PA has developed a methodology to address any emerging risk under additional risk categories such as Turbulence. The RASG-PA also ensures that the regional safety performance is shared through the annual RASG-PA Safety Report.

Promoting Audit Standards for Operators with Smaller Aircraft Types

Extending the benefits of IOSA through the ISSA to operators with smaller aircraft types to improve the transport of passengers safely in the Americas region, led to the partnership with ALTA. This partnership saw results with five new operators whose business model did not conform to IOSA become part of the ISSA registry, after successful completion of the ISSA Implementation Training (IIT) program sponsored by the International Airline Training Fund (IATF). These operators have now aligned their operations with international best practices and improved their operational safety and efficiency.

Americas Insight Analysis

Accidents in the Pan-America Region showed a decreasing trend across the five-year period analyzed (2015-2019). However, analysis of the high-risk accident categories shows LOC-I trends for the region above world averages, while the rest of the high-risk categories (CFIT, RE and precursors to MAC) are below world averages.

Use of GADM analysis to drive implementation of CSTs and improvements of safety levels across various airspaces in the region continues to emphasize the need for data-driven decision-making.

In the Pan-America Region, the number of States above the 60% level of Effective Implementation (EI) of the ICAO Standards and Recommended Practices improved with a decrease from eight States to seven in 2019, according to the ICAO Universal Safety Oversight Audit Program (USOAP) Continuous Monitoring Approach (CMA).

The region's operators continue to see nonconformity with SMS practices as required by IOSA dealing with the management of safety risk associated with aircraft operations.

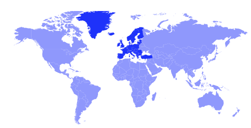
The technical risk estimates for 2018 satisfy the goal of not exceeding the target level of safety in Reduced Vertical Separation Minimum (RVSM) airspace. It is important to note that risk-attributing factors show an increasing trend overall.

The NAT region continues to work toward attainment of its mid-term targets regarding implementation of the ICAO SSP in alignment with the Global Aviation Safety Plan.

In the operational environment, when evaluating the contributing factors in relation to human factors for the events that occurred in the NAT region, the most error types were "actions" of flight crew and ATC compared to the other human factor areas evaluated.

The Americas region is collaborating with South Atlantic (SAT) area industry stakeholders to improve safety and efficiency. As part of the improved coordination needed for the SAT region, a joint task force (Atlantic Coordination Group) has been formed to support improvements concerning interoperability and safety oversight, including enhancement of efficiency in the Europe/South America airspace corridor.

Europe Region (EUR)



Performance-based Regulation/Oversight

One of IATA's priorities in Europe is advocating that the European Union Regulatory Environment adopts a performance/risk-based approach in harmonization with global aviation standards that does not represent an undue burden for air operators. To achieve this, IATA is maintaining close cooperation with EASA, attending relevant focused consultations and providing comments to EASA Notices of Proposed Amendments (NPAs). IATA promotes the development of new and revised regulations in the EU as a result of collaborative work with industry instead of being driven by public opinion and media pressure.

IATA is part of the EASA expert group tasked with defining a European Ground Handling Roadmap within EASA's work on establishing more detailed rules and acceptable means of compliance to complement the essential requirements for Ground Handling Services as stated in the EASA Basic Regulation (EU) 2018/1139 (applicable since 11 September 2018). IATA promotes the use of existing industry standards as the recognized basis for new regulations.

As part of cooperation with regulatory and safety oversight authorities, IATA proposes to make use of existing recognized industry programs within SSPs. In 2019, four States within Europe have signed MoUs with IATA on the use of IOSA and/or ISAGO as a complement to regulatory oversight: Moldova, Georgia, Latvia and Germany. More States are showing interest in similar cooperation with IATA.

To raise awareness of its safety-related programs, IATA delivered the following workshops in the European Region in 2019:

- ISAGO workshops in Madrid (29-30 May), Baku (2-3 July, hosted and supported by the Interstate Aviation Council), London (22-23 October) and Tbilisi (26-27 November)
- GADM workshop in Madrid (31 May)
- IOSA workshop in Madrid (4-5 December)

Cooperation with ICAO EUR

IATA is cooperating closely with ICAO EUR by participating in and contributing to several ICAO working groups at various levels, including:

- ICAO Regional Aviation Safety Group (RASG-EUR)
- RASG Coordination Group (RCOG)
- ICAO European Regional Expert Safety Team (IE-REST)
- ICAO Language Proficiency Requirements Implementation Task Force (LPRI TF)

In 2019, RASG-EUR was merged with the European Air Navigation Planning Group (EANPG) to create the European Regional Aviation System Planning Group (EASPG), ensuring more coordination between safety and operational issues.

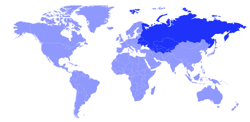
Regional targets for fatality risk reduction are being developed within RASG-EUR activities. Taking into consideration the Global Safety Aviation Plan (GASP) objectives as well as reactive safety information from previous years (accident and incident data) and proactive safety information (safety oversight audit and SMS/SSP assessments) from the EUR/NAT regions, the safety priorities for RASG-EUR are:

- Runway Safety
- Loss of Control – In-flight
- Controlled Flight into Terrain
- Safety Oversight Capabilities
- Air Navigation Deficiencies
- Safety Management

Emerging risks considered by RASG-EUR included continuous increase of GPS outages and occurrences involving drones or Remotely Piloted Aircraft Systems (RPAS).

A regional overview of the safety-enhancement initiatives in the RASG-EUR Region, including contribution from IATA, is published in the annual RASG-EUR Safety Report. The latest one can be found on the ICAO website.

Commonwealth of Independent States (CIS)



Enhancement of Safety Awareness in CIS

- One of the major projects that IATA is contributing to in the CIS Region is the ICAO-IAC RER/01/901 project named "Development of operational safety and continuing airworthiness for contracting States of the international agreement", which has been active for 19 years. Within this project, in cooperation with ICAO, the Interstate Aviation Committee (IAC) and Airbus, IATA delivered or contributed to the following events in CIS in 2019:
- Safety Culture Workshop (Moscow, 4-5 March)
- Conference on Information Systems Usage in Safety Management (Moscow, August)
- 5th Regional Safety Seminar organized by Air Astana (Almaty, Kazakhstan, 22-23 September)

The aim of these seminars is to bring together speakers from all over the world to share industry best practices and enhance safety awareness in Central Asia.

Support to States

One of IATA's objectives is to support States by encouraging better use of existing IATA programs and tools, including IOSA, IGOM, ISAGO, and ISSA. If deemed possible, IATA also provides necessary training to relevant stakeholders in the pertinent States.

For three years, IATA has provided the above-mentioned support to Kyrgyzstan, while other organizations assisted the State in enhancing State oversight. In 2019, Kyrgyzstan resolved its Significant Safety Concern from the ICAO USOAP audit.

In 2019, IATA started supporting the CAA of Moldova. Within the framework of the MoU signed between IATA and the CAA of Moldova, the IATA Training Fund provided training to the CAA inspectors to complete the IATA Diploma in Safety Oversight.

Cooperation to Ensure a Safer Airspace in Azerbaijan

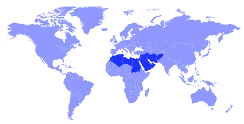
In 2019, IATA and the Azerbaijan Air Navigation Service Provider (AZANS) achieved an important milestone in their joint project, which aims to develop the SMS of AZANS to achieve implementation Level C ("Managed"), in accordance with EASA requirements.

During the year, IATA extensively supported AZANS in the implementation of advanced safety and risk management standards, including the delivery of relevant training to personnel. It was agreed that IATA would continue to support AZANS in implementing its National Airspace Strategy (NAS).

In addition, IATA is willing to support Azerbaijan Airlines´ initiative to integrate ATC systems with unmanned aerial systems (Air Traffic Management and Unmanned Traffic Management unification).

This is not the only area of cooperation between AZAL and IATA. In 2019, AZAL and IATA signed a Letter of Interest, including, among other issues, support of the implementation of various IATA safety programs and tools (e.g., IOSA and ISAGO) in Azerbaijan.

Middle East and North Africa Region (MENA)



Work continued with regional organizations through RASG-MID where MENA holds the vice-chair of the group and leads the Regional Aviation Safety Team (RAST) and Annual Safety Report Team (ASRT). The focus for 2020 is to achieve a continuous reduction in operational safety risks. The safety risks identified based on the analysis of available safety data include:

- Runway Safety (RS), mainly RE and Abnormal Runway Contact (ARC) during landing
- Loss of Control – In-flight
- Controlled Flight into Terrain
- Mid-Air Collision

In addition, a list of emerging risks has been identified:

- Fire/Smoke – nonimpact (F-NI)
- Wake Turbulence
- Runway Incursion (RI)
- Bird Strike (BIRD)
- Security (SEC)
- System Component Failure – Powerplant (SCF-PP)
- System Component Failure – Non-Powerplant (SCF-NP)
- Wind Shear

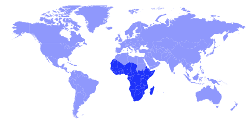
GNSS Vulnerability has been identified as a safety concern and the main challenge impeding the implementation of Performance-based Navigation (PBN) in the MID Region. IATA MENA continues to work closely with all concerned stakeholders (States, ICAO and ITU) on measures to ensure effective reporting of GNSS interferences and developing mitigation measures to reduce the effect of the interference. The RASG-MID Safety Advisory (RSA-14 Guidance Material Related to GNSS Vulnerabilities) was developed with close coordination with ICAO MID.

MENA was successful in including the use of the ISAGO certification and IGOM in the RAG-MID safety strategy where States are requested to endorse ISAGO and IGOM as a reference for ground handling safety standards.

Slow progress in the implementation of SMS by air operators (non-IATA members), as well as maintenance and training organizations continues. A survey was conducted by IATA to collect information on SMS implementation to ascertain the status of implementation.

MENA was successful in promoting the IOSA and ISAGO audit programs among airlines and State authorities. Three States (Egypt, Jordan and Kuwait) signed safety MoU Annexes (Egypt: ISAGO) (Jordan: IOSA) (Kuwait: IOSA and ISAGO) recognizing the programs as an acceptable means to complement their oversight obligations.

Africa and Indian Ocean Region (AFI)



The Regional Aviation Safety Group — Africa and Indian Ocean (RASG-AFI) was first established in March 2012 in Kampala, Uganda.

IATA continues to hold the vice-chairmanship of the group and is the industry representative. RASG-AFI consists of several safety support teams that focus on high-risk areas, namely:

- Significant Safety Concerns (SSCs)
- Fundamentals of Safety Oversight (FSO)
- Accident Investigation Group (AIG)
- Emerging Safety Concerns (ESI)
- Annual Safety Report Team (ASRT)

The ASRT is currently chaired by the Assistant Director, Safety & Flight Operations, AME. The ASRT is responsible for collecting and analyzing safety information as well as identifying safety focus areas for the AFI aviation community. 2020 will see production of the 6th Edition of the RASG-AFI Annual Safety Report (ASR).

IATA has been very actively involved as part of the Runway Safety Go Missions, which have seen the establishment of over 20 Runway Safety Teams (RSTs) in AFI. In 2019, two new RSTs were established and follow-up was done to strengthen five previously established RSTs.

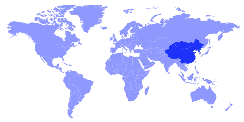
RASG-AFI has been charged with monitoring the progress of States in implementing/meeting the Abuja Safety Targets, which were set by the Ministerial Meeting of July 2012 with the ultimate goal of driving down the AFI overall accident rate toward the global average.

For the first time, in 2018, IATA launched a Third Country Operator (TCO) awareness project in AFI for the sole purpose of educating primarily member airlines and, in turn, their respective CAA to better understand the application process. The program, which was fully supported by EASA, mainly targeted those States that were impacted by the EU Safety List. The aim was to leave these operators and/or States in a position where they fully understand the TCO process and associated requirements to the extent they can minimize the chances of being on the List. And, if they are already listed, equip them on how to work toward removal. The TCO awareness work continued in 2019 with further campaigns (one in Southern Africa and another in West Africa).

Promotion of Audit Programs

AFI made some significant progress in promoting IOSA and ISSA programs. It gained its first operator (Kenyan-based) on the ISSA registry, which is also true for the entire Africa and Middle East regions. There was further signing of an MoU on ISSA with the African Airlines Association (AFRAA). The State of Mozambique also signed an MoU on IOSA recognition.

North Asia Region (NASIA)



The SFO NASIA desires to improve the efficiency of flight operations and to promote the overall safety level in the region. The following are achievements highlighted in 2019.

IATA China ATFM Liaison Desk

The IATA China Air Traffic Flow Management (ATFM) Liaison Desk aims to support operations in the China mainland and enhance the efficiency of communication between IATA member airlines and the Civil Aviation Administration of China (CAAC). According to statistics, the Liaison Desk assisted with 732 cases of operational issues (increased by 117% compared to 2018) and distributed 1,122 Massive Delay Response System (MDRS) warning messages in 2019. Also, the Liaison Desk has been moved to the Air Traffic Management Bureau (ATMB), CAAC headquarters since April and a face-to-face working mechanism has been established.

Open Access to CAAC Meteorology Website

Many foreign airlines requested CAAC to provide real-time meteorological information, considering they operate in Chinese domestic airports. With the effort of SFO NASIA, the Aviation Meteorological Center (AMC) of ATMB opened access to the Meteorology Website for foreign airlines.

Coordination with CAAC on Contingency Flight Routes

During the period of Pakistan airspace closure and Iran airspace instability, SFO NASIA worked together with CAAC to open contingency flight routes for airlines, which improved safety and the efficiency of operations to some extent.

Opening Beijing Daxing International Airport

Beijing Daxing International Airport has been in operation since September 2019. During the airspace switchover period, SFO NASIA worked closely with CAAC and member airlines to ensure safe operations.

Promoting IOSA and ISAGO

SFO NASIA desires to develop further cooperation and improve mutual understanding with CAAs in the region. In 2019, IOSA and ISAGO MoUs were signed separately with Macau CAA and Hong Kong Civil Aviation Department (HKCAD). In addition, SFO NASIA invited inspectors from CAAC to take part in the IOSA workshop in June in Montreal, which provided CAAC with a good opportunity to understand this program well.

The regional ISAGO workshop was held in Beijing in August, which attracted many airlines, GSPs, airports and authorities to participate. As at the time of writing, 20 GSPs have been registered in the region and two airlines have become ISAGO members (Xiamen Airlines and China Southern Airlines). Furthermore, with the effort of SFO NASIA, collecting GSP network information in NASIA was successfully achieved and the percentage of submission was nearly 80%.

Chengdu Tianfu International Airport

In 2019, SFO NASIA delivered a workshop regarding the Beijing Daxing International Airport for North China Regional ATMB and it obtained much positive feedback from all stakeholders. Therefore, another workshop for Chengdu New Airport was held in December, as requested by Southwest China Regional ATMB. The workshop was focused on the operations of converging runways and Terminal Control Area (TMA) airspace design, and was considered very helpful and successful.

1

IATA Annual Safety Report

Safety is aviation's highest priority. More than 70 years ago, the global airline industry came together to create the International Air Transport Association (IATA). As part of IATA's mission to represent, lead and serve its members, the association partners with aviation stakeholders to collect, analyze and share safety information. It also advocates for global safety standards and best practices that are firmly founded on industry experience and expertise. A vital tool in this effort is IATA's annual Safety Report, which is now in its 56th year of publication. This is the definitive yearbook to track commercial aviation's safety performance, challenges and opportunities.

The IATA Safety Report has been IATA's flagship safety document since 1964. This document provides the industry with critical information, derived from the analysis of aviation accidents, to understand safety risks in the industry and propose mitigations.

The 2019 Safety Report was produced at the beginning of 2020 and presents trends and statistics based on knowledge of the industry at that time. This report is made available to the industry for free distribution.

The IATA Safety Report is a valuable tool as aviation works tirelessly to improve its already superb safety record.

Image courtesy of Bombardier

SAFETY REPORT METHODS AND ASSUMPTIONS

The IATA Safety Report is produced each year and designed to present the best-known information at the time of publication. Due to the nature of accident analysis, certain caveats apply to the results of this report. Firstly, that the accidents analyzed and the categories and contributing factors assigned to those accidents are based on the best available information at the time of classification. Secondly, that the sectors used to create the accident rates are the most up-to-date available at the time of production. The sector information is updated on a regular basis and takes into account actual and estimated data. As new updates are provided the sector count becomes more accurate for previous years, which in turn allows for increased precision in the calculation of accident rates.

ACCIDENT CLASSIFICATION TECHNICAL GROUP

The Accident Classification Technical Group (ACTG) was created to analyze accidents, identify contributing factors, determine trends and areas of concern relating to operational safety, and develop prevention strategies. The results of the work of the ACTG are incorporated in this annual IATA Safety Report.

It should be noted that many accident investigations are not complete at the time the ACTG meets to classify the year's events and additional facts may be uncovered during an investigation that could affect the currently assigned classifications.

The ACTG is composed of safety experts from IATA, member airlines, Original Equipment Manufacturers (OEMs), professional associations and federations as well as other industry stakeholders. The group is instrumental in the analysis process and produces a safety report based on the subjective classification of accidents. The data analyzed and presented in this report is extracted from a variety of sources, including FlightGlobal and the accident investigation boards of the States where the accidents occurred. Once assembled, the members of the ACTG validate each accident report using their expertise to develop an accurate assessment of the events.

2019 ACTG members:

Capt. Ruben Morales
(Chairman)
HONG KONG EXPRESS

Capt. Takahisa Otsuka
(Vice-Chairman)
JAPAN AIRLINES

Dr. Dieter Reisinger
AUSTRIAN AIRLINES

Mr. Marcel Comeau
AIR CANADA

Mr. Xavier Barriola
AIRBUS

Capt. Jeff Perin
AIR LINE PILOTS ASSOCIATION (ALPA)

Mrs. Tatyana Morozova
AIR ASTANA

Mr. Nicolas Bornand
AIR FRANCE

Mrs. Alice Calmels
ATR

Capt. Jorge Robles
AVIANCA

Capt. Ivan Carvalho
AZUL BRAZILIAN AIRLINES

Capt. Robert Aaron Jr.
THE BOEING COMPANY

Capt. Sam Goodwill
THE BOEING COMPANY

Mr. Eric East
THE BOEING COMPANY

Mr. David Fisher
BOMBARDIER AEROSPACE

Mr. Luis Savio dos Santos
EMBRAER

Mr. Yasuo Ishihara
HONEYWELL

Capt. Suha Senol
TURKISH AIRLINES

Capt. Arnaud Du Bédat
IFALPA

Capt. Takahisa Otsuka
JAPAN AIRLINES

Mr. Martin Plumleigh
JEPPESEN

Capt. Peter Krupa
LUFTHANSA

Capt. Andreas Poehlitz
LUFTHANSA

Capt. Ayedh Almotairy
SAUDI ARABIAN AIRLINES

Capt. NIlesh Patil
SINGAPORE AIRLINES

Capt. HockKeat Ho
SINGAPORE AIRLINES

Capt. Antonio Jose dos Santos Gomes
TAP AIR PORTUGAL

Capt. B. Pete Kaumanns
VEREINIGUNG COCKPIT

Mr. Greg Brock
WORLD METEOROLOGICAL ORGANIZATION

Mr. Steve Hough
BAINES SIMMONS

Mr. Riccardo Petrucci
ATR

Mr. David Monteith
DE HAVILLAND

Capt. Mark Searle
IATA

Mr. Gabriel Acosta
IATA

Mr. Andrea Mulone
IATA

Mrs. Hanada Said
IATA

2

Decade in Review

AIRCRAFT ACCIDENTS AND FATALITIES

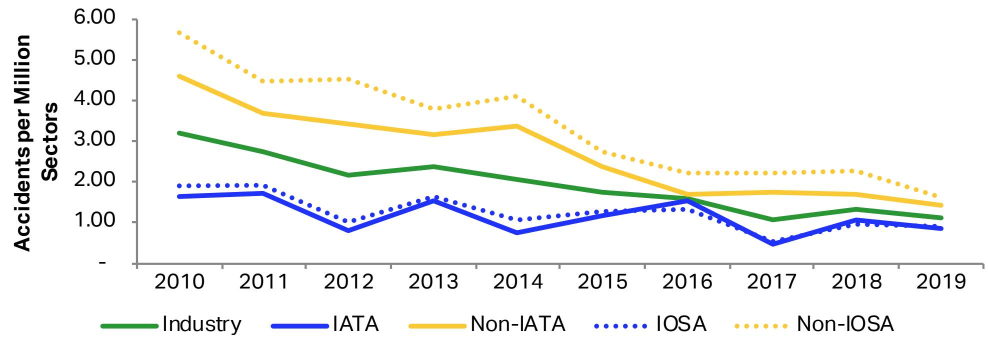
This section presents yearly accident rates for the past 10 years for each of the following accident metrics: all accidents, fatality risk, fatal accidents and hull losses, as well as general statistics on the number of fatalities and accident costs.

Image courtesy of Embraer

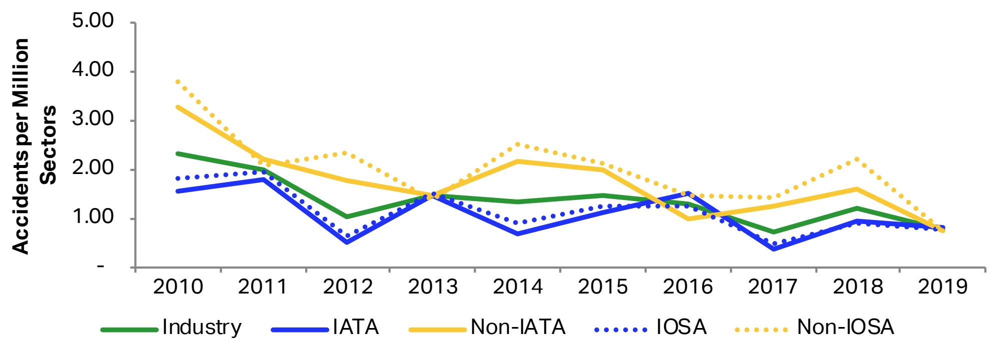
ALL ACCIDENTS

'All Accidents' is the most inclusive rate, including all accident types and all severities in terms of loss of life and damage to aircraft.

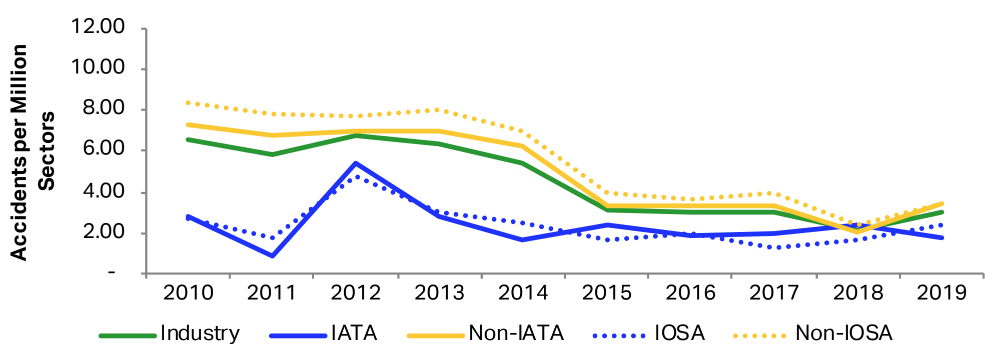
Jet & Turboprop Aircraft



Jet Aircraft



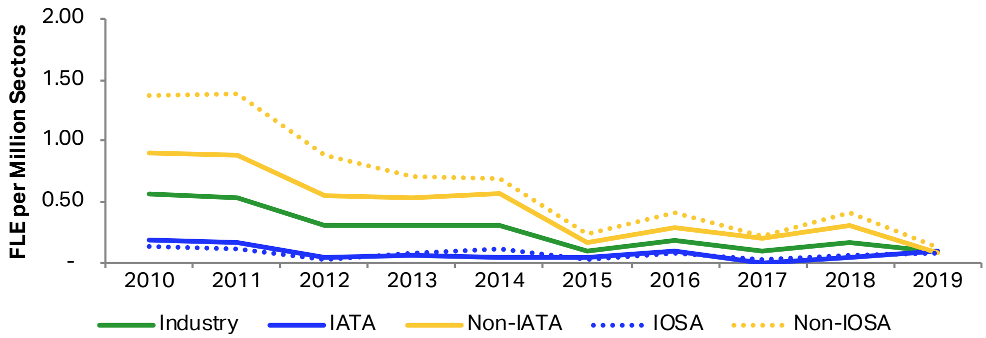
Turboprop Aircraft



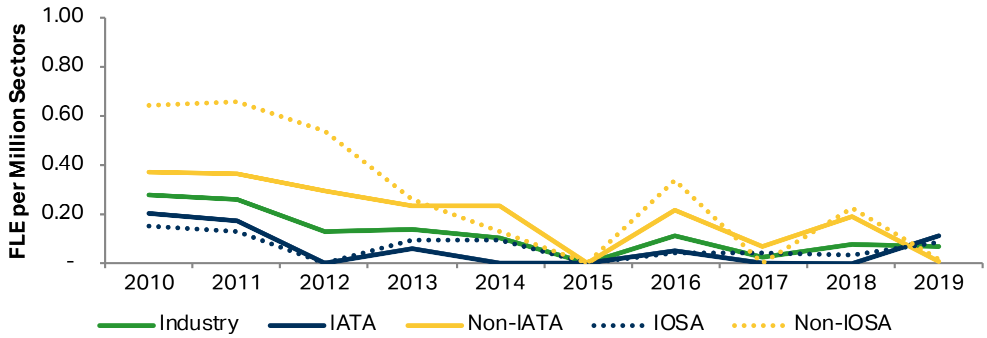
FATALITY RISK

Fatality Risk: Full-Loss Equivalents (FLE) per million sectors. For a definition of 'full-loss equivalent', please see Annex 1.

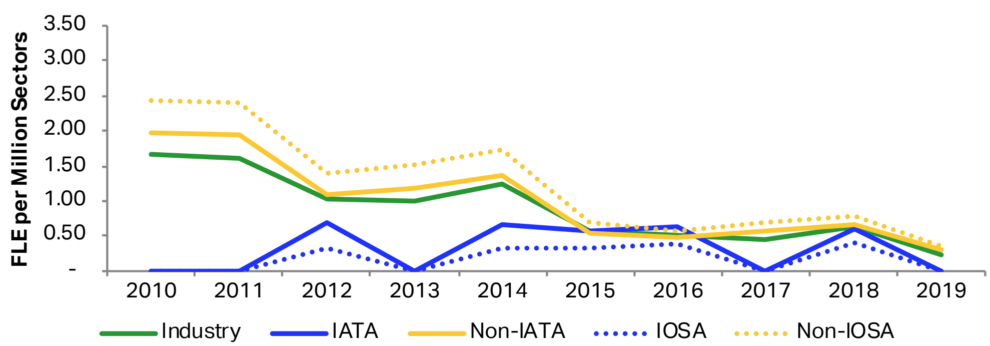
Jet & Turboprop Aircraft



Jet Aircraft



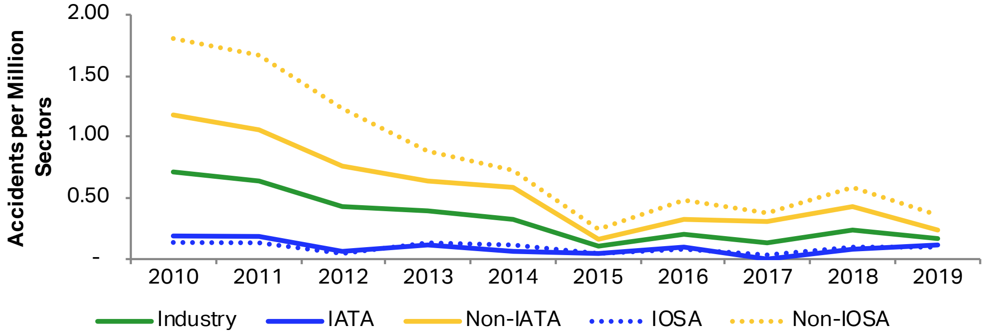
Turboprop Aircraft



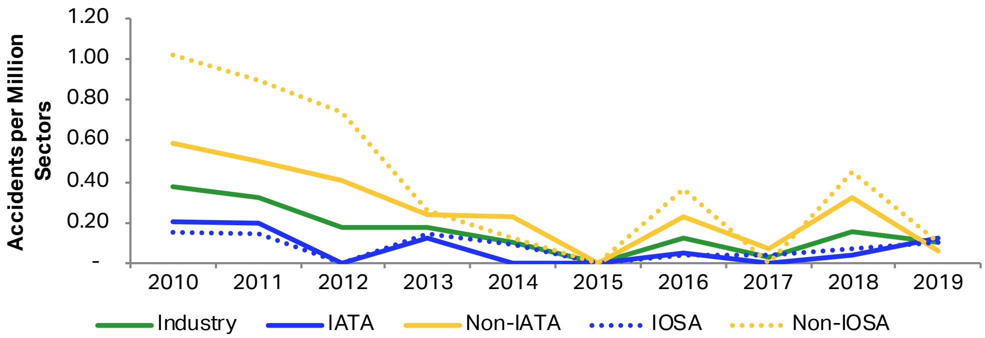
FATAL ACCIDENTS

'Fatal Accidents' refers to accidents with at least one person on board the aircraft perishing as a result of the crash.

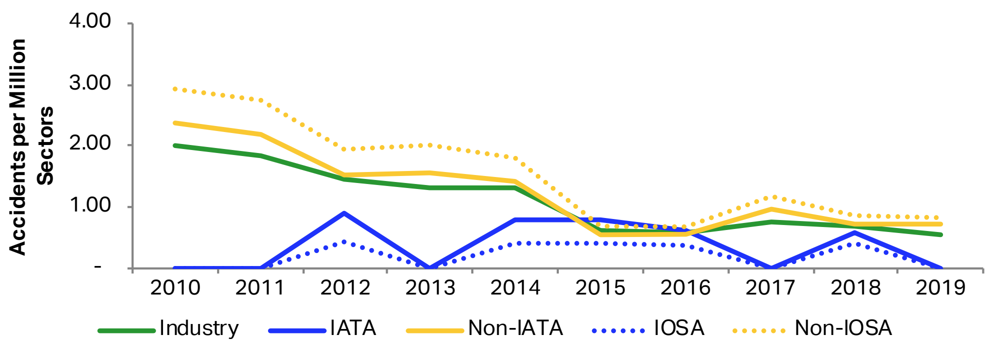
Jet & Turboprop Aircraft



Jet Aircraft



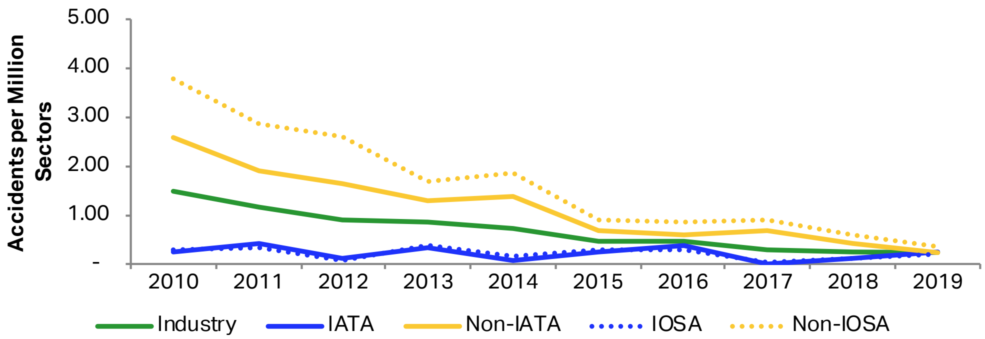
Turboprop Aircraft



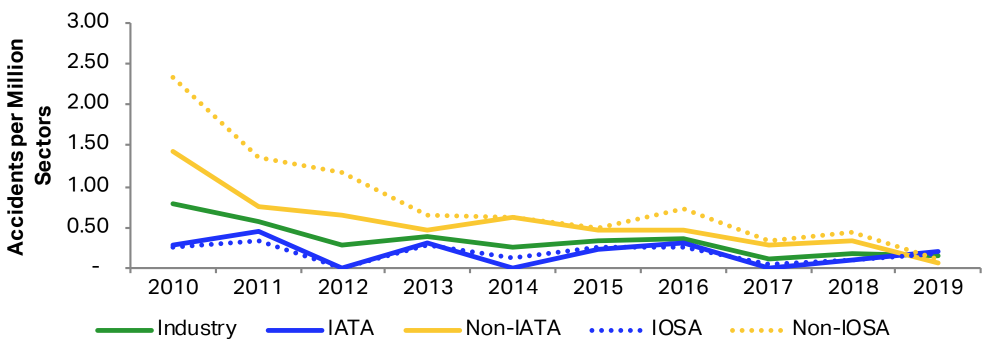
HULL LOSSES

'Hull Losses' refers to the aircraft being damaged beyond repair or the costs related to the repair being above the commerical value of the aircraft.

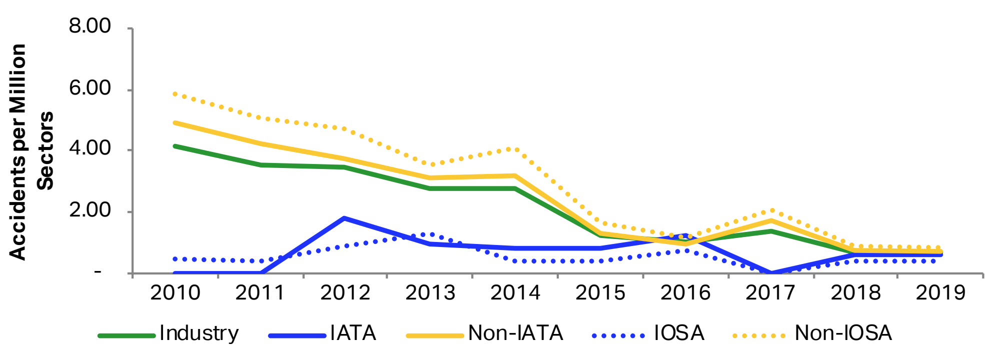
Jet & Turboprop Aircraft



Jet Aircraft



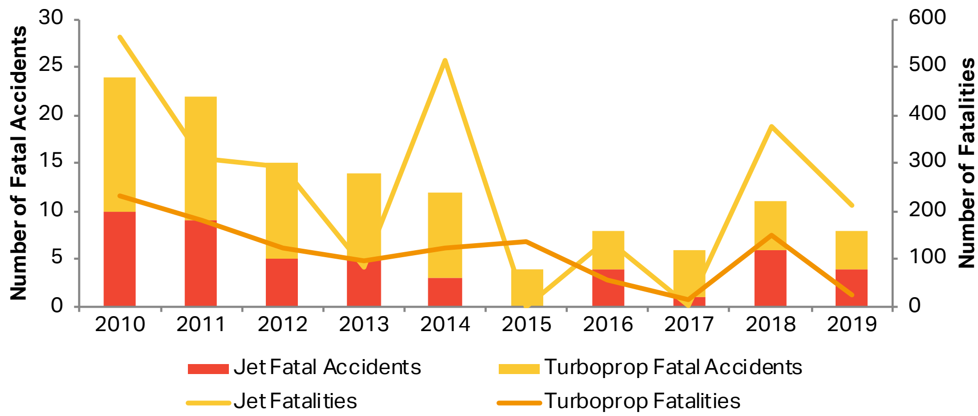
Turboprop Aircraft



FATALITIES

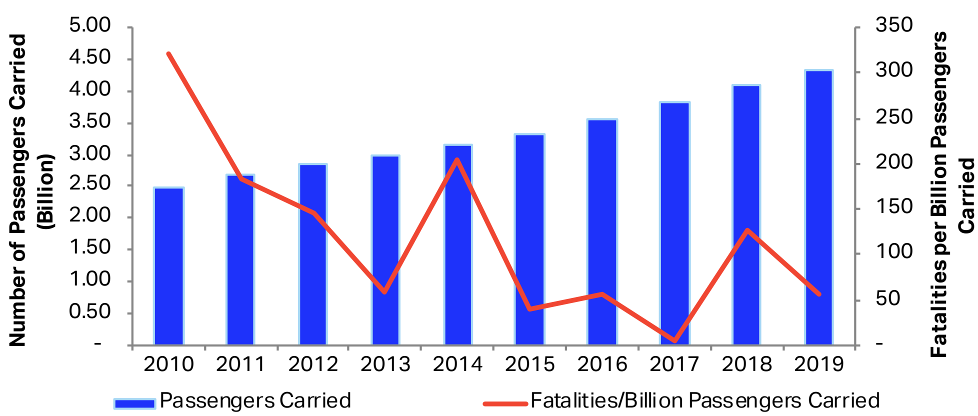
The graph below shows the total number of fatalities (lines and vertical right axis) and the number of fatal accidents (stacked bars and vertical left axis) split between aircraft propulsion type. The data is not normalized by the aircraft flight count; therefore, discretion should be used when interpreting and applying this data. It should be used in reference to the accident rate graphs presented above.

Number of Fatalities and Fatal Accidents



The graph below shows the constant increase in the number of passengers carried over the past 10 years as well as a ratio metric related to the number of fatalities by the number of passengers carried in a specific year.

Number of Passengers Carried and Fatality Ratio per Passengers Carried

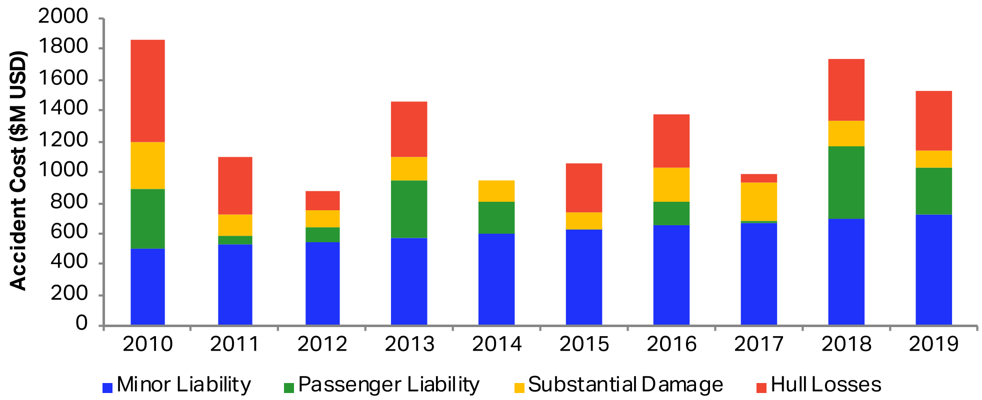


Passengers Carried Data Source: [IATA / Industry Economic Performance]

ACCIDENT COSTS

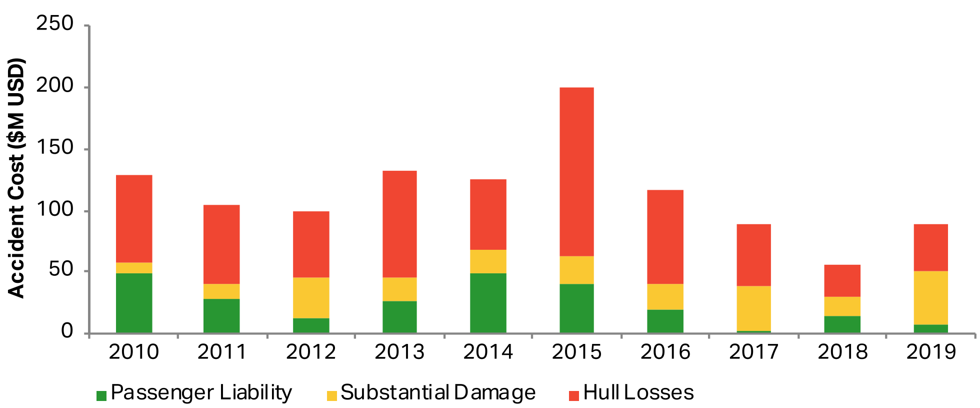
The graphs below show the estimated costs for all losses involving jet and turboprop aircraft over the last 10 years. The figures presented are from operational accidents and exclude security-related events and acts of violence.

Jet Aircraft



Source: Ascend FlightGlobal

Turboprop Aircraft



Source: Ascend FlightGlobal

3

2019 in Review

COMMERCIAL AIRLINES OVERVIEW

FLEET SIZE AND SECTORS FLOWN

	Jet	Turboprop	Total
World Fleet	27,988	5,311	33,299
Sector Landings (Millions)	39.6	7.3	46.8

Source: Ascend - a FlightGlobal Advisory Service
Note: World Fleet includes in-service and stored aircraft operated by commercial airlines as at year-end 2019.

CARGO OPERATING FLEET

	Jet	Turboprop
Percentage of Operating Fleet in All-Cargo Use	7.6%	18.7%

Source: Ascend - a FlightGlobal Advisory Service
Note: Operating Fleet includes in-service and stored aircraft operated by commercial airlines as at year-end 2019.

REGIONAL BREAKDOWN

	AFI	ASPAC	CIS	EUR	LATAM/CAR	MENA	NAM	NASIA
Jet - Sector Landings (Millions)	0.72	6.28	1.36	8.58	2.70	2.11	11.26	6.54
Turboprop - Sector Landings (Millions)	0.77	1.83	0.13	1.45	0.76	0.14	2.08	0.12

AIRCRAFT ACCIDENTS

Note: Summaries of all the year's accidents are presented in Annex 3.

NUMBER OF ACCIDENTS

	Jet	Turboprop	Total
Total	31	22	53
Hull Losses	6	5	11
Substantial Damage	25	17	42
Fatal	4	4	8
Full-Loss Equivalents	2.6	1.7	4.3
Fatalities*	213	27	240
Fatalities of people not on board the aircraft	*0*	*7*	*7*

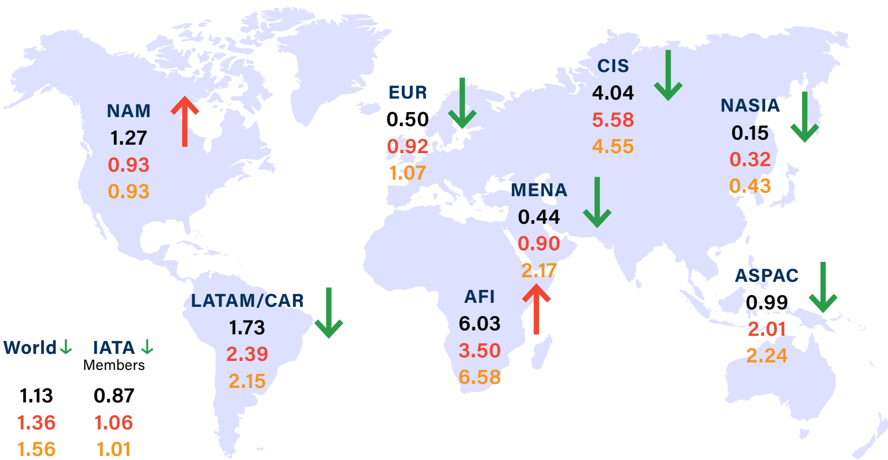
**People on board only*

ACCIDENTS PER OPERATOR REGION

	AFI	ASPAC	CIS	EUR	LATAM/CAR	MENA	NAM	NASIA
Total	9	8	6	5	6	1	17	1
Hull Losses	2	1	5	0	1	0	1	1
Substantial Damage	7	7	1	5	5	1	16	0
Fatal	2	0	4	0	0	0	2	0
Full-Loss Equivalents	2.0	0.0	1.3	0.0	0.0	0.0	1.0	0.0
Fatalities	176	0	60	0	0	0	4	0

ALL ACCIDENT RATE

Jet & Turboprop Aircraft

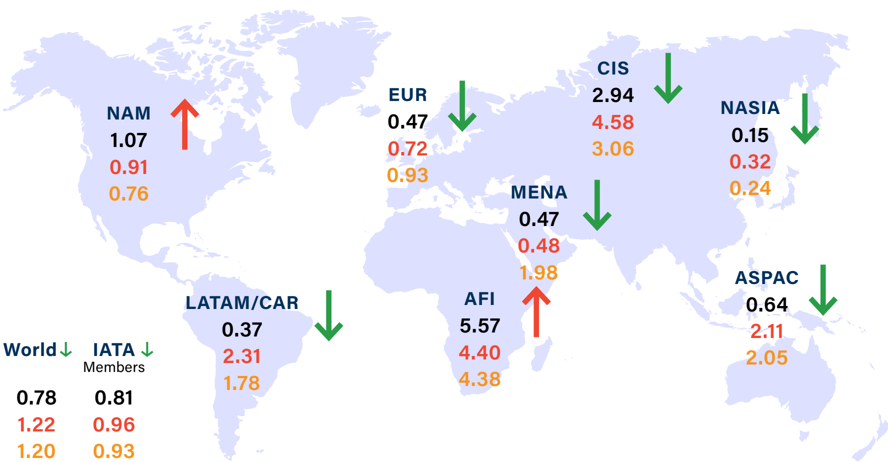


2019 vs 2018 accident rate

2019
2018
'14-'18

In 2019, in 6 of 8 IATA regions, the Accident Rate decreased compared to 2018.

Jet Aircraft

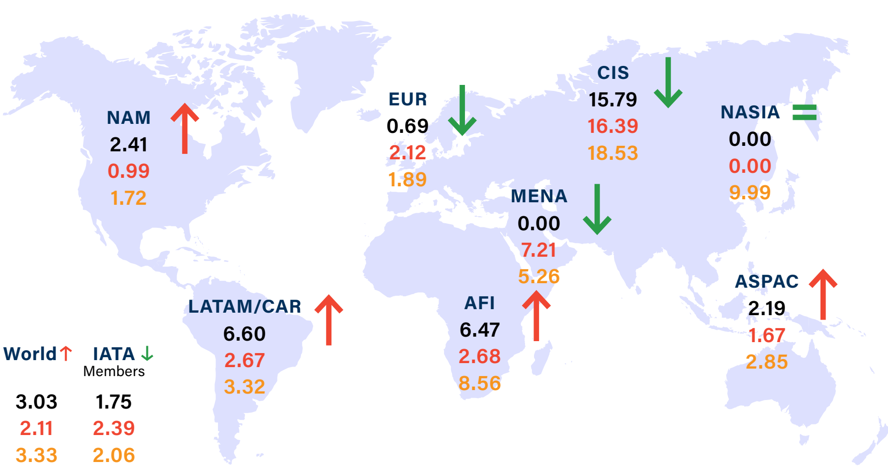


2019 vs 2018 accident rate

2019
2018
'14-'18

In 2019, in 6 of 8 IATA regions, the Jet Rate decreased compared to 2018.

Turboprop Aircraft



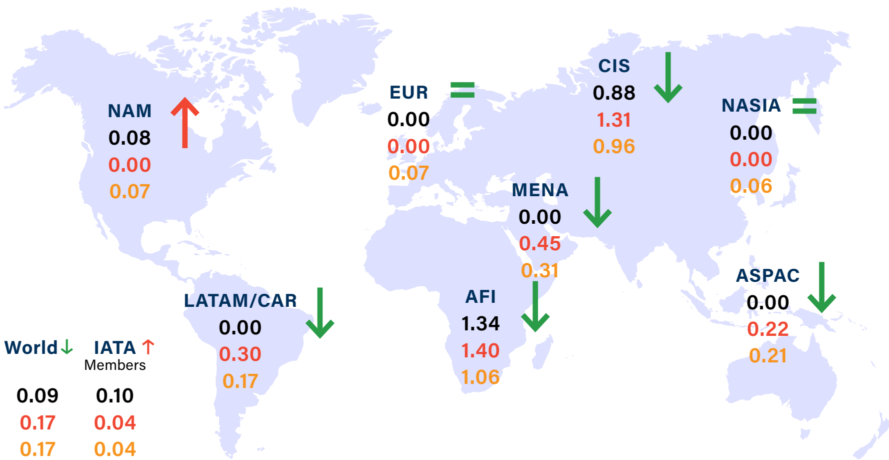
2019 vs 2018 accident rate

2019
2018
'14-'18

In 2019, in 3 of 8 IATA regions, the Turboprop Rate decreased compared to 2018.

FATALITY RISK

Jet & Turboprop Aircraft

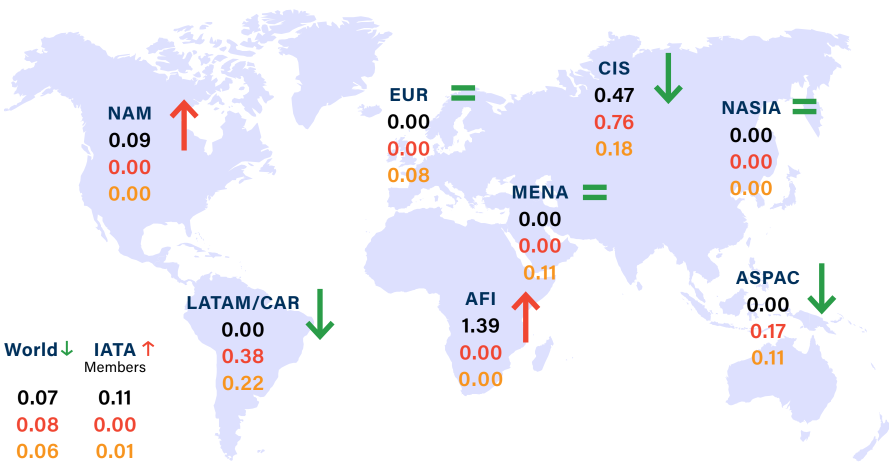


2019 vs 2018 accident rate

2019
2018
'14-'18

In 2019, in 1 of 8 IATA regions, Fatality Risk increased compared to 2018.

Jet Aircraft

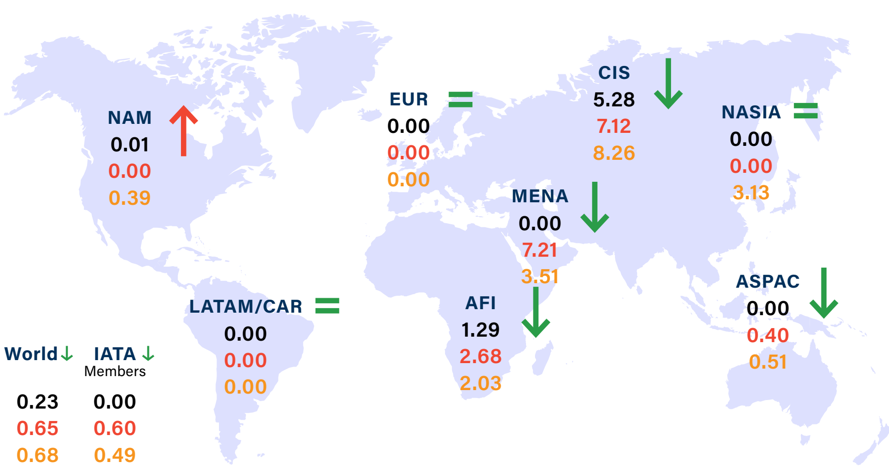


2019 vs 2018 accident rate

2019
2018
'14-'18

In 2019, Jet Fatality Risk increased in AFI and NAM compared to 2018.

Turboprop Aircraft



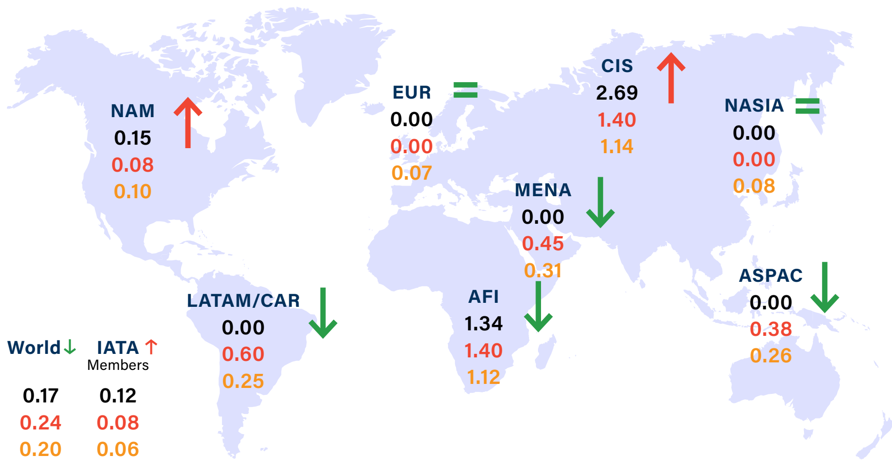
2019 vs 2018 accident rate

2019
2018
'14-'18

In 2019, Turboprop Fatality Risk slightly increased in NAM compared to 2018.

FATAL ACCIDENTS RATE

Jet & Turboprop Aircraft

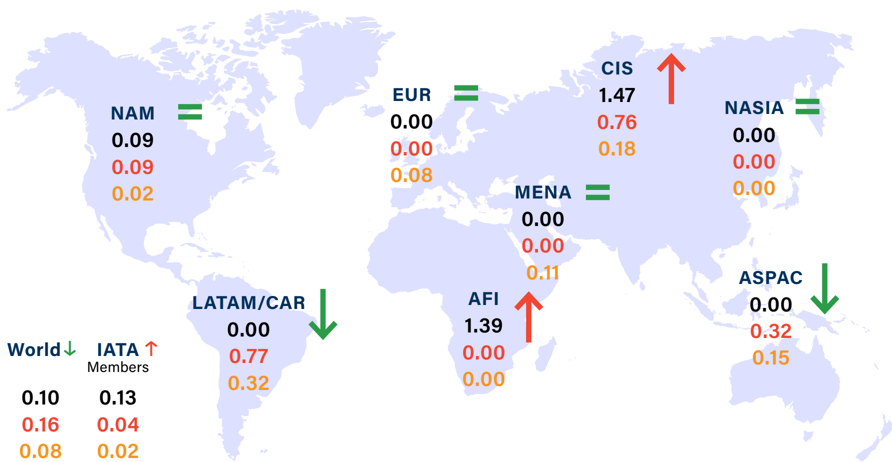


2019 vs 2018 accident rate

2019
2018
'14-'18

In 2019, Fatal Accident Rate increased in NAM and CIS compared to 2018.

Jet Aircraft

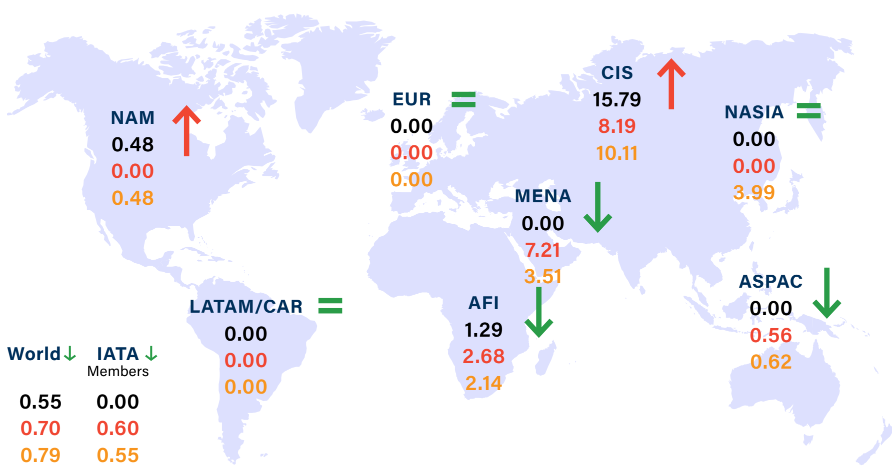


2019 vs 2018 accident rate

2019
2018
'14-'18

In 2019, Jet Fatal Accident Rate increased in CIS and AFI compared to 2018.

Turboprop Aircraft



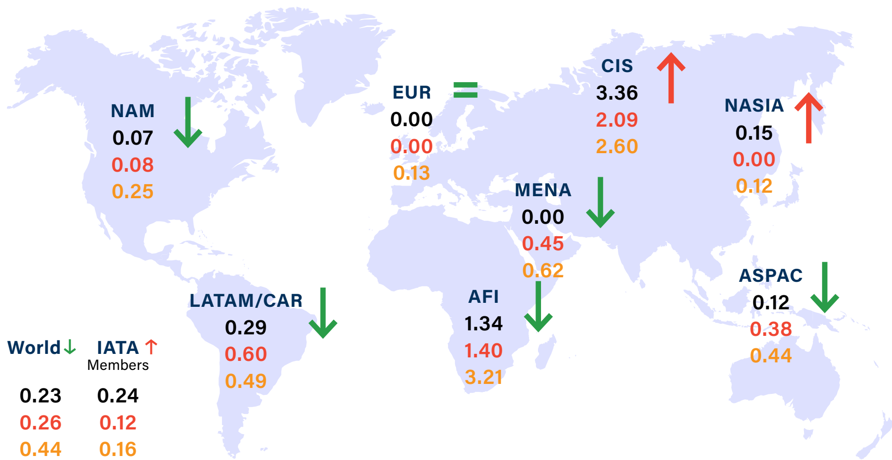
2019 vs 2018 accident rate

2019
2018
'14-'18

In 2019, Turboprop Fatal Accident Rate increased in NAM and CIS compared to 2018.

HULL LOSS RATE

Jet & Turboprop Aircraft

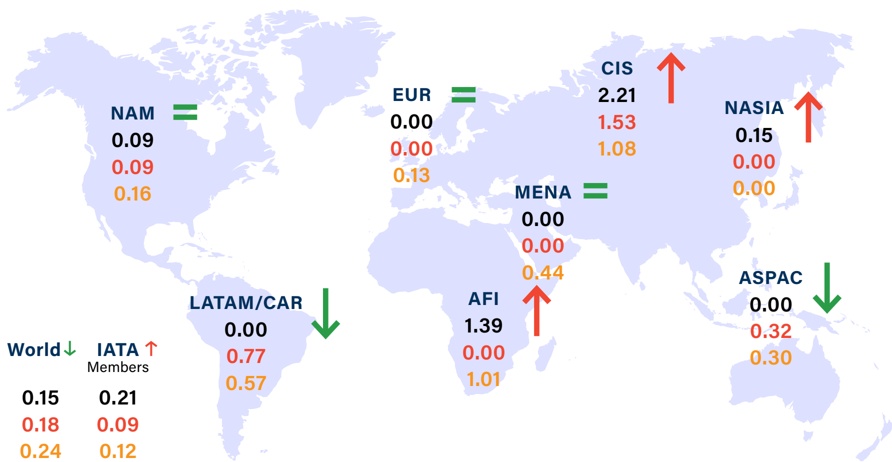


2019 vs 2018 accident rate

2019
2018
'14-'18

In 2019, Hull Loss Accident Rate increased in CIS and NASIA compared to 2018.

Jet Aircraft

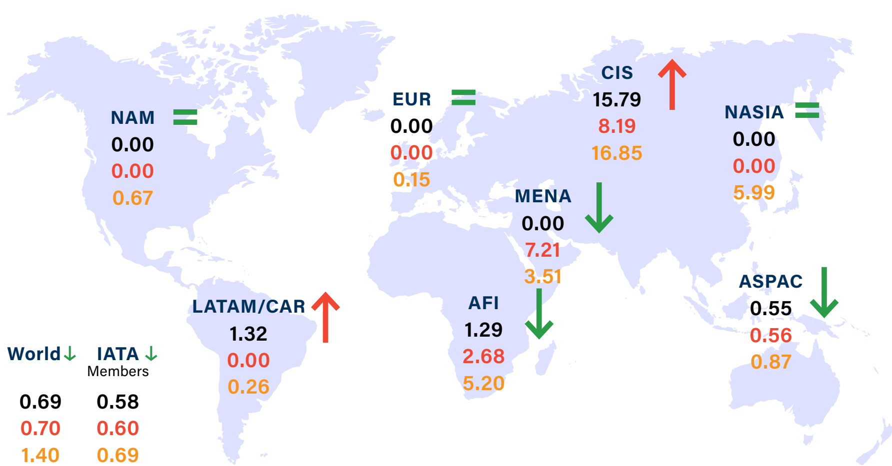


2019 vs 2018 accident rate

2019
2018
'14-'18

In 2019, Jet Hull Loss Rate increased in CIS, NASIA and AFI compared to 2018.

Turboprop Aircraft



2019 vs 2018 accident rate

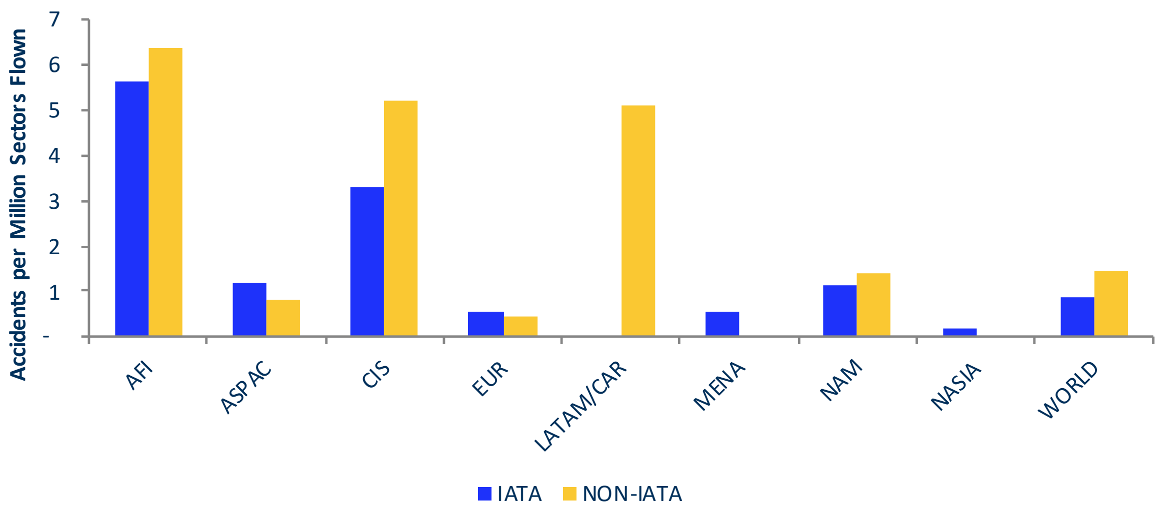
2019
2018
'14-'18

In 2019, Turboprop Hull Loss Rate increased in CIS and LATAM/CAR compared to 2018.

IATA Member Airlines vs. Nonmembers – Total Accident Rate by Region

In an effort to better indicate the safety performance of IATA member airlines vs. nonmembers, IATA has determined the total accident rate for each, regionally and globally. IATA member airlines outperformed nonmembers in the AFI, CIS, LATAM/CAR and NAM regions.

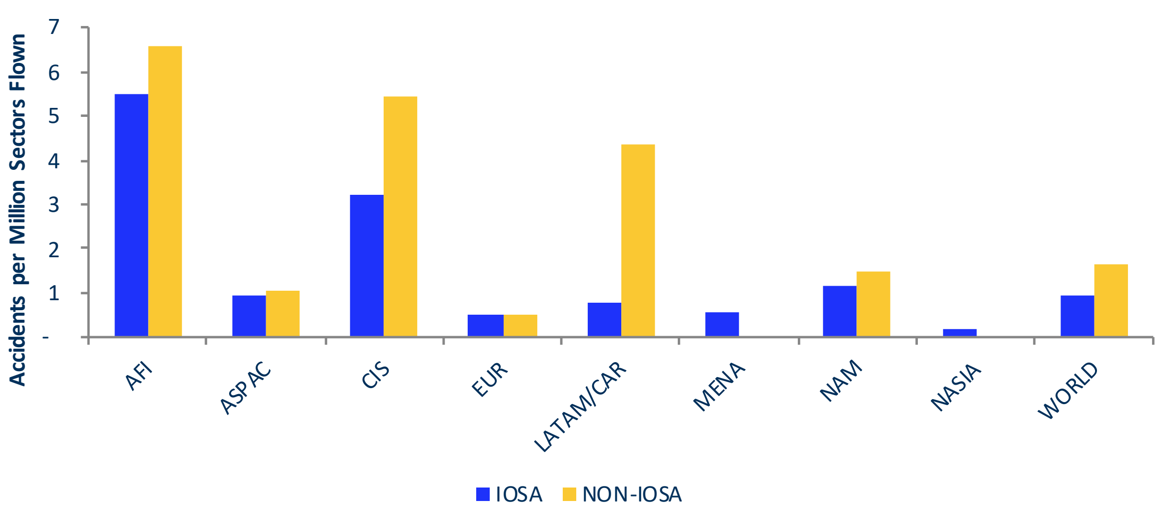
2019 Accident Rate: IATA Member Airlines vs. Nonmembers



IOSA-Registered Airlines vs. Non-IOSA –Total Accidents and Fatalities by Region

In an effort to better indicate the safety performance of IOSA-registered airlines vs. non-IOSA, IATA has determined the total accident rate for each, regionally and globally. IOSA-registered airlines outperformed non-registered airlines in the AFI, ASPAC, CIS, EUR, LATAM/CAR and NAM regions. The non-IOSA-registered airline accident rate was more than two times higher than for IOSA-registered airlines in 2019.

2019 Accident Rate: IOSA-Registered vs. Non-Registered



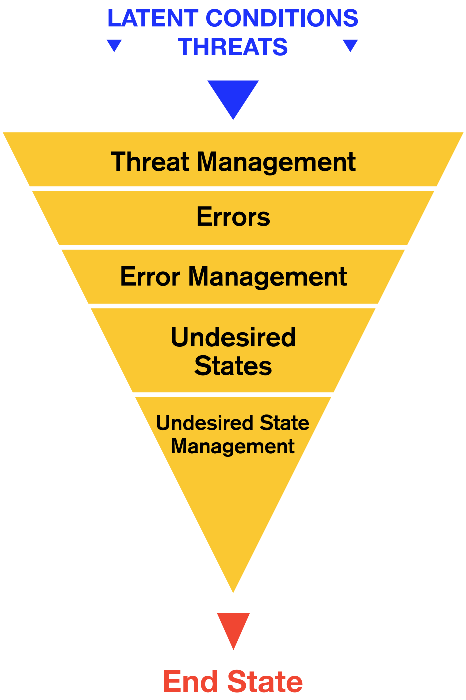
4

In-Depth Accident Analysis 2015 to 2019

INTRODUCTION TO THREAT AND ERROR MANAGEMENT

The Human Factors Research Project at the University of Texas in Austin developed Threat and Error Management (TEM) as a conceptual framework to interpret data obtained from both normal and abnormal operations. For many years, IATA has worked closely with the University of Texas Human Factors Research Team, ICAO, IATA member airlines and manufacturers to apply TEM to its many safety activities.

THREAT AND ERROR MANAGEMENT FRAMEWORK



DEFINITIONS

Latent Conditions: Conditions present in the system before the accident, made evident by triggering factors. These often relate to deficiencies in organizational processes and procedures.

Threat: An event or error that occurs outside the influence of the flight crew, but which requires flight crew attention and management to properly maintain safety margins.

Flight Crew Error: An observed flight crew deviation from organizational expectations or crew intentions.

Undesired Aircraft State (UAS): A flight crew-induced aircraft state that clearly reduces safety margins; a safety compromising situation that results from ineffective TEM. An UAS is recoverable.

End State: An end state is a reportable event. An End State is unrecoverable.

Distinction between 'Undesired Aircraft State' and 'End State': An UAS is recoverable (e.g., an unstable approach from which a go-around would recover the situation). An End State is unrecoverable (e.g., a runway excursion where the aircraft comes to rest off the runway).

ACCIDENT CLASSIFICATION SYSTEM

At the request of member airlines, manufacturers and other organizations involved in the Safety Report, IATA developed an accident classification system based on the TEM framework. The purpose of the taxonomy is to:

- Acquire more meaningful data
- Extract further information/intelligence
- Formulate relevant mitigation strategies/safety recommendations

Unfortunately, some accident reports do not contain sufficient information at the time of the analysis to adequately assess contributing factors. When an event cannot be properly classified due to a lack of information, it is classified under the Insufficient Information category. Where possible, these accidents have been assigned an End State. It should also be noted that the contributing factors that have been classified do not always reflect all the factors that played a part in an accident, but rather those known at the time of the analysis.

Important note: In the in-depth analysis presented in Sections 4 through 6, the percentages shown with regards to contributing factors (e.g., % of threats and errors noted) are based on the number of accidents in each category. Accidents classified as "Insufficient Information" are excluded from this part of the analysis. The number of "Insufficient Information" accidents is noted at the bottom of each analysis section of contributing factors in Addendums A, B and C. However, accidents classified as "Insufficient Information" are part of the overall statistics (e.g., % of accidents that were fatal or resulted in a hull loss).

Annex 1 contains definitions and detailed information regarding the types of accidents and aircraft that are included in the Safety Report analysis as well as the breakdown of IATA regions.

The complete IATA TEM-based accident classification system for flight is presented in Annex 2.

ORGANIZATIONAL AND FLIGHT CREW-AIMED COUNTERMEASURES

Every year, the ACTG classifies accidents and, with the benefit of hindsight, determines actions or measures that could have been taken to prevent an accident. These proposed countermeasures are in two categories, systemic countermeasures and last-line-of-defense countermeasures that frontline personnel could action. Systemic countermeasures can be put in place by operators or state regulators. These countermeasures are based on activities, processes or systemic issues internal to the airline operation or State's oversight activities. Frontline personnel countermeasures are primarily directed toward flight crew and may have been effective in managing the threat or errors identified in the accident analysis.

Countermeasures for other personnel, such as air traffic controllers, ground crew, cabin crew or maintenance staff are important, but they are not considered in this report at this time.

Each event was coded with potential countermeasures that, with the benefit of hindsight, could have altered the outcome of events. A statistical compilation of the countermeasures is presented in Section 8 of this report.

ANALYSIS BY ACCIDENT CATEGORY AND REGION

This section presents an in-depth analysis of 2015 to 2019 occurrences by accident category and regional distribution. Definitions of these categories can be found in Annex 2. The countries that make up each of the IATA regions can be found in Annex 1 – Definitions. An in-depth regional analysis can be found in Section 5.

Referring to these accident categories helps an operator to:

- Structure safety activities and set priorities
- Recall key risk areas, when a type of accident does not occur in a given year
- Provide resources for well-identified prevention strategies
- Address these categories, both systematically and continuously, within the airline's safety management system

Evidence-Based Training (EBT)

The aim of an EBT program is to identify, develop and evaluate the competencies required by pilots to operate safely, effectively and efficiently in a commercial air transport environment, by managing the most relevant threats and errors, based on evidence collected in operations and training.

Why?

Overall Flight crew performance is the primary contributing factors for accidents and incidents. The Evidence-Based Training (EBT) initiative propose an innovative pilot training methodology, which arose from concerns that traditional recurrent training and checking were no longer meeting the needs of airline pilots.

IATA's Role?

Since 2008, IATA has led the development of EBTand has supported its implementation across the world. EBT has been endorsed by ICAO in 2013, mixed EBT is possible in Europe since 2016 and EASA will enable full EBT implementation in 2020. Over 50 airlines are engaged in the development of EBT for their own organizations in various stages of readiness. A team of IATA current and experienced captains can assist airlines, ATOs and CAAs with all aspects of EBT implementation.

IATA Consulting can assist you with every aspect of EBT's implementation

EBT Pre-Implementation

- Deliver awareness workshop(s) to top management and operational staff.
- Assess organization (AOC-ATO) needs.
- Propose options and associated EBT implementation plan.
- Buy-in from your CAA.
- Support internal EBT awareness and communication plan.

Competencies for Pilots and Instructors

- Support the definition and implementation of your pilot and instructor competency grading system.
- Train and assess your EBT instructor core group in accordance to your competency performance standards.

EBT Program Design

- Support EBT program design (including malfunction and approach type clustering).

EBT tools

- Propose technical solutions for training data collection and analysis.

EBT Monitoring

- Propose technical solutions for training data collection and analysis.
- Adjustment and continuous improvement of the training program (based on training system feedback).

CONTACT

If you need help to qualify a lead, prepare a proposal or want more information on EBT, contact EBT@IATA.org

IATA Consulting

2019 Aircraft Accidents – Accident Count

Number of accidents: 53
Number of fatalities: 240

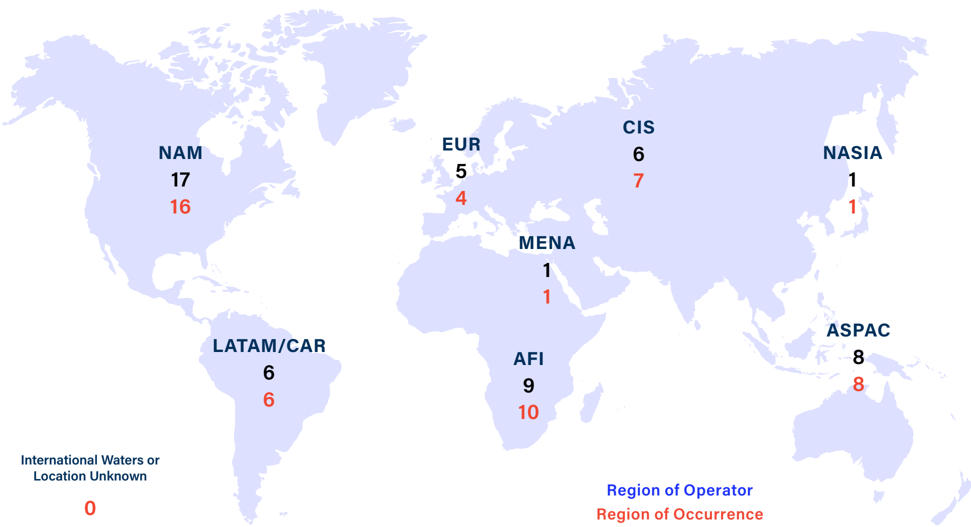
Accident Count % of Total	2019
IATA Member	42%
Full-Loss Equivalents	8%
Fatal	15%
Hull Losses	21%

Passenger	Cargo	Ferry	Jet	Turboprop
91%	9%	0%	58%	42%

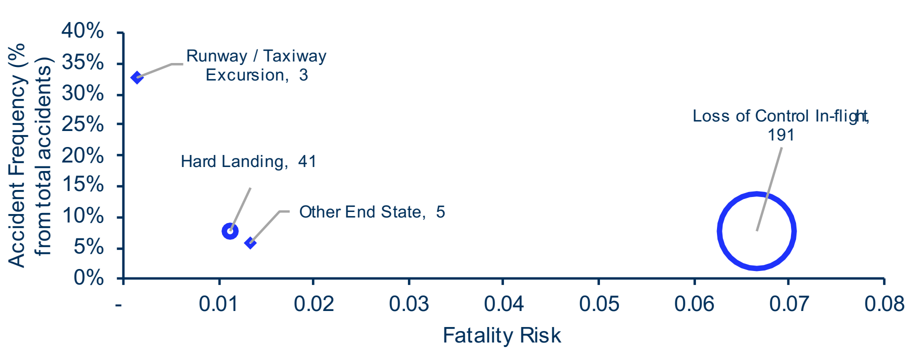
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Safety Management:
32%

Threats

Meteorology:
43%

Flight Crew Errors

Manual Handling/ Flight Controls:
45%

Undesired Aircraft State

Long/floated/bounced/firm/ off-center/crabbed landing:
30%

Countermeasure

In-flight decision-making/ contingency management and Monitor/Cross-check:
21%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

2019 Aircraft Accidents – Accident Rate*

Accident rate*: 1.13

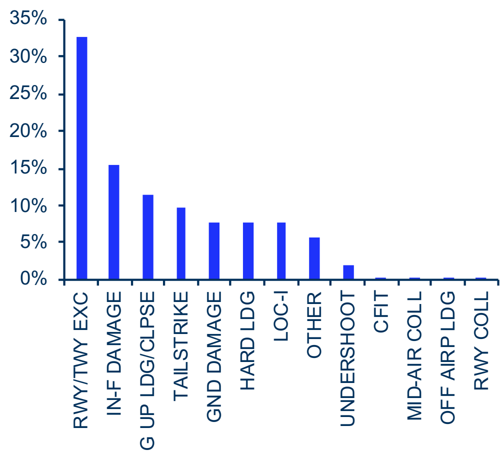
Accident Rate*	2019
IATA Member	0.87
Fatality Risk**	0.09
Fatal	0.17
Hull Losses	0.23

Jet	Turboprop	
0.78*	**3.03***	Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2019)

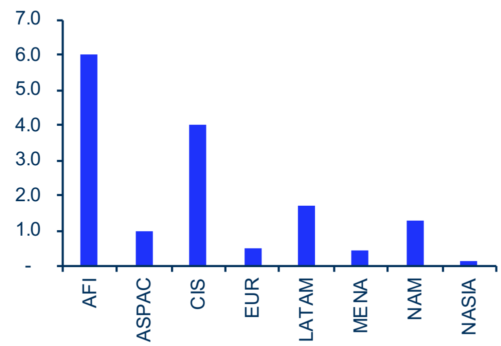
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

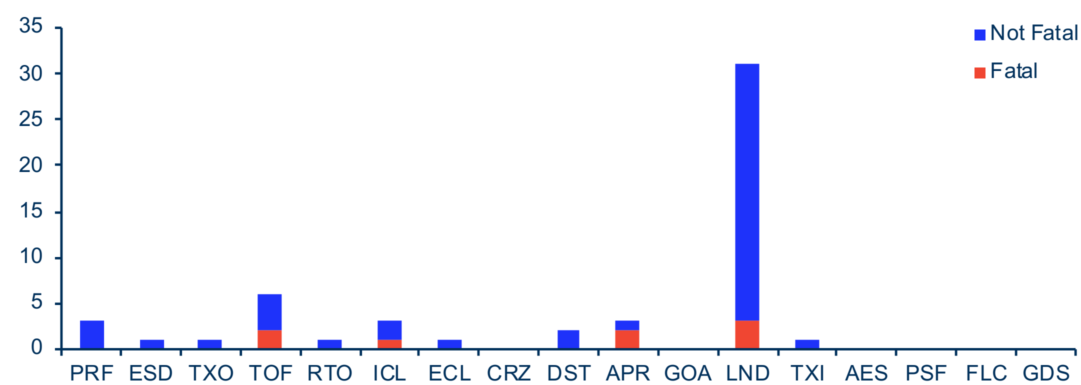
Regional Accident Rate (2019)

Accidents per Million Sectors



Accidents per Phase of Flight (2019)

Total Number of Accidents (Fatal vs. Nonfatal)



Refer to list of Phase of Flight definitions for full names

2015-2019 Aircraft Accidents – Accident Count

Number of accidents: 292
Number of fatalities: 1116

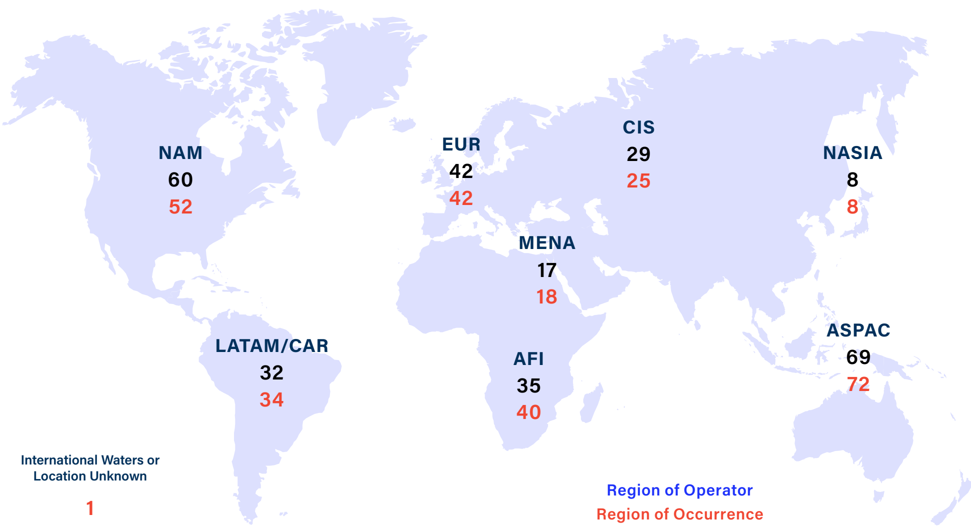
Accident Count % of Total	2015-2019
IATA Member	39%
Full-Loss Equivalents	9%
Fatal	13%
Hull Losses	25%

Passenger	Cargo	Ferry	Jet	Turboprop
82%	17%	1%	66%	34%

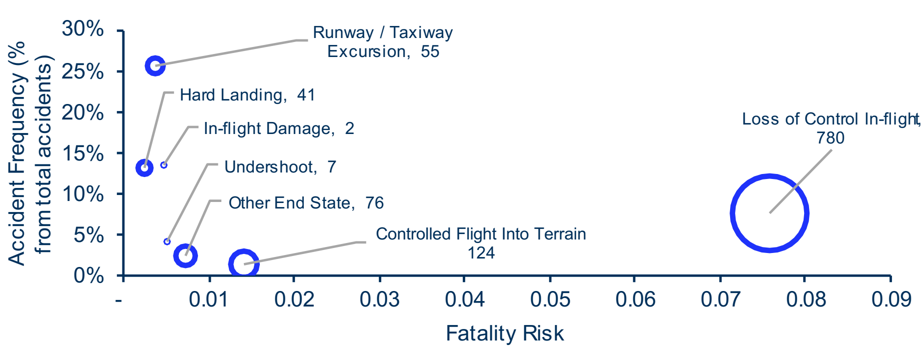
Note: the sum may not add to 100% due to rounding.

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Regulatory Oversight:
32%

Threats

Meteorology:
36%

Flight Crew Errors

Manual Handling/Flight Controls:
39%

Undesired Aircraft State

Long/floated/bounced/firm/off-center/crabbed landing:
24%

Countermeasure

Overall Crew Performance:
27%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

2015-2019 Aircraft Accidents – Accident Rate*

Accident rate*: 1.38

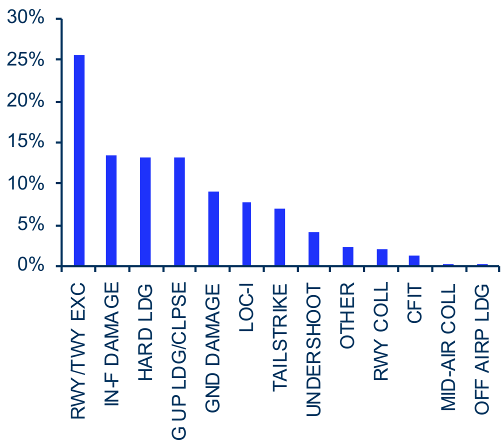
Accident Rate*	2015-2019
IATA Member	1.01
Fatality Risk**	0.13
Fatal	0.17
Hull Losses	0.34

Jet	Turboprop	
1.09	2.86	Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

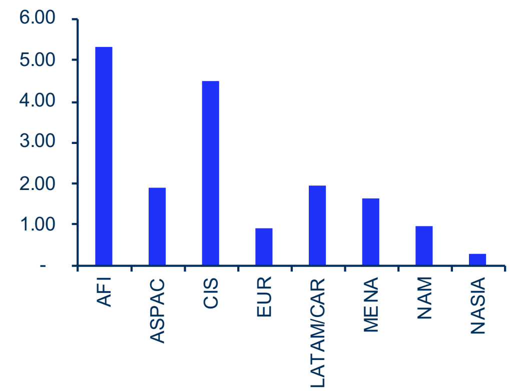
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

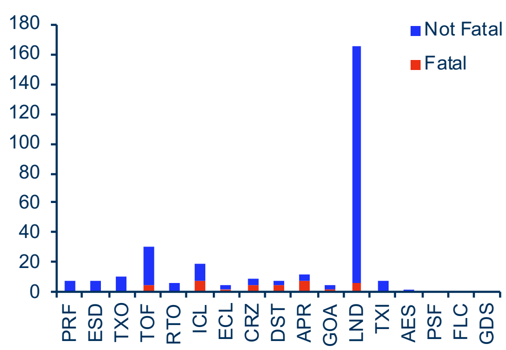
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



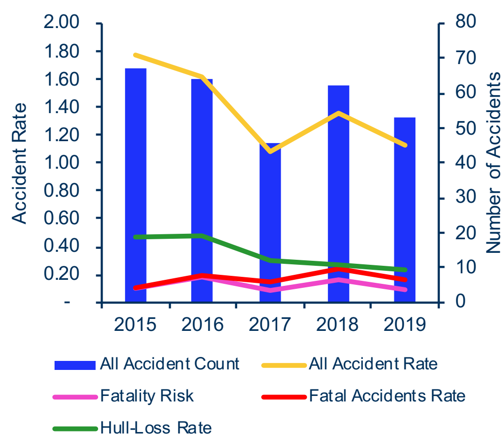
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



2015-2019 Fatal Aircraft Accidents – Accident Count

Number of accidents: 37
Number of fatalities: 1116

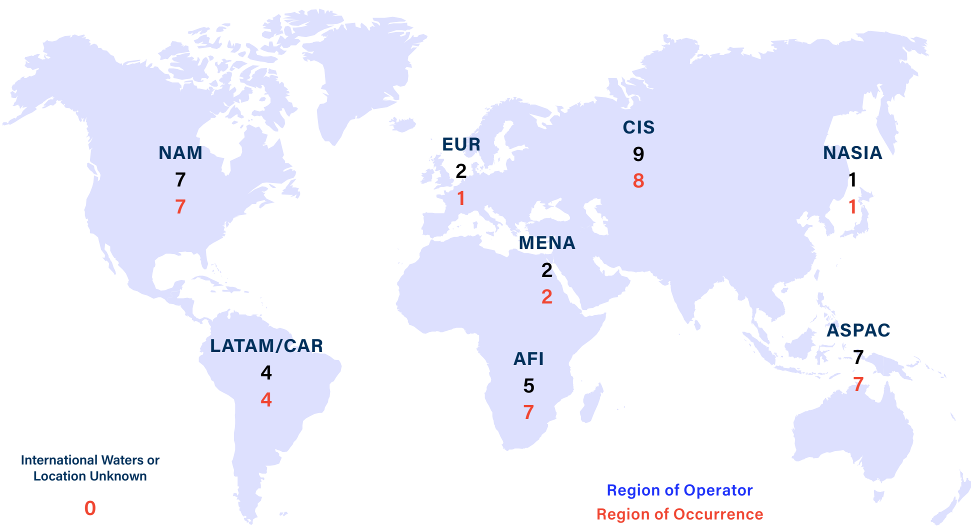
Accident Count % of Total	2015-2019
IATA Member	22%
Full-Loss Equivalents	73%
Fatal	100%
Hull Losses	92%

Passenger	Cargo	Ferry	Jet	Turboprop
59%	41%	0%	41%	59%

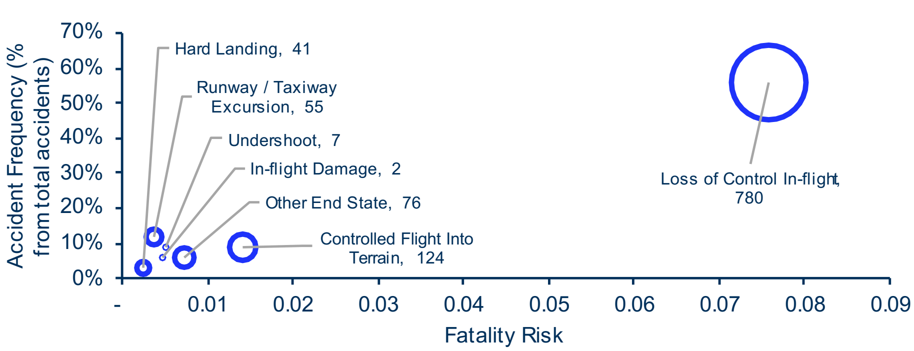
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Safety Management:
61%

Threats

Meteorology:
48%

Flight Crew Errors

SOP Adherence / SOP Cross-verification:
58%

Undesired Aircraft State

Vertical / Lateral / Speed Deviation:
42%

Countermeasure

Monitor / Cross-check:
52%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

2015-2019 Fatal Aircraft Accidents – Accident Rate*

Accident rate*: 0.17

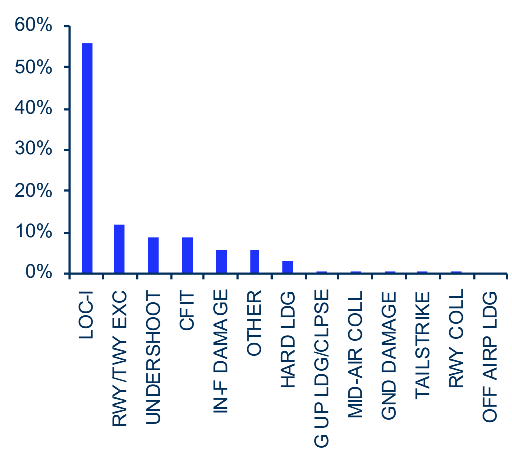
Accident Rate*	2015-2019
IATA Member	**0.07**
Fatality Risk**	**0.13**
Fatal	**0.17**
Hull Losses	**0.16**

Jet	Turboprop	
0.08	**0.63**	Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

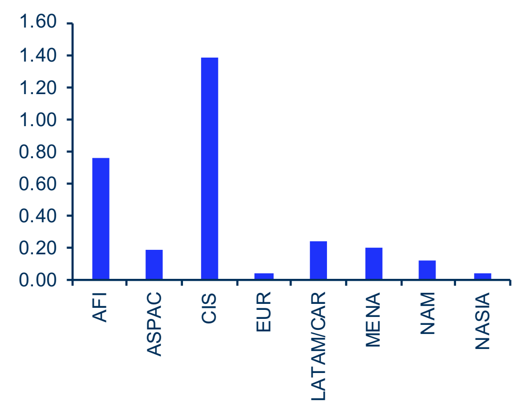
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

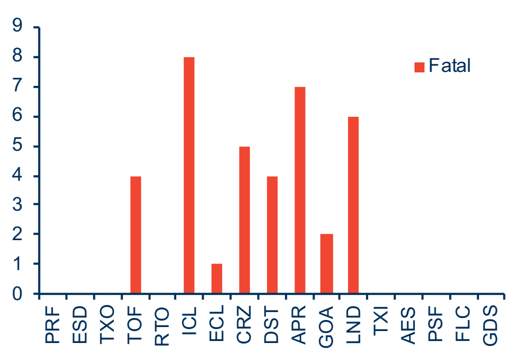
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



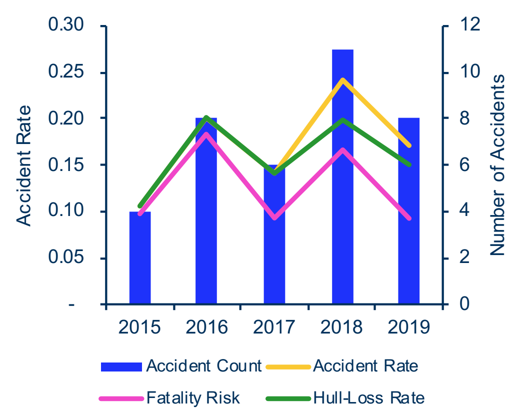
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal)



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



2015-2019 Nonfatal Aircraft Accidents – Accident Count

Number of accidents: 255
Number of fatalities: 0

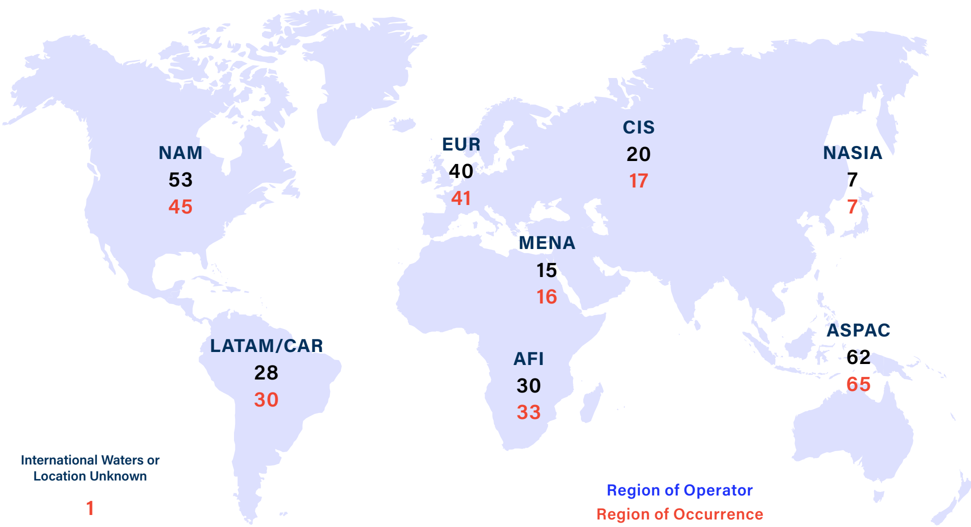
Accident Count % of Total	2015-2019
IATA Member	42%
Full-Loss Equivalents	0%
Fatal	0%
Hull Losses	15%

Passenger	Cargo	Ferry	Jet	Turboprop
85%	14%	1%	70%	30%

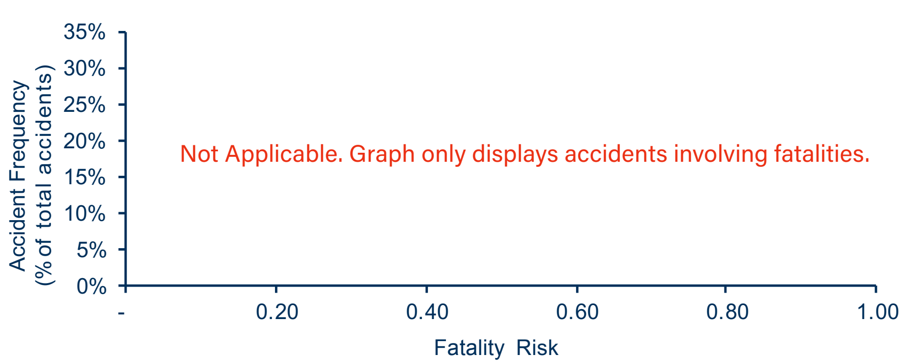
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Regulatory Oversight:
29%

Threats

Meteorology:
34%

Flight Crew Errors

Manual Handling/Flight Controls:
38%

Undesired Aircraft State

Long/floated/bounced/firm/off-center/crabbed landing:
26%

Countermeasure

Overall Crew Performance:
24%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

2015-2019 Nonfatal Aircraft Accidents – Accident Rate*

Accident rate*: 1.20

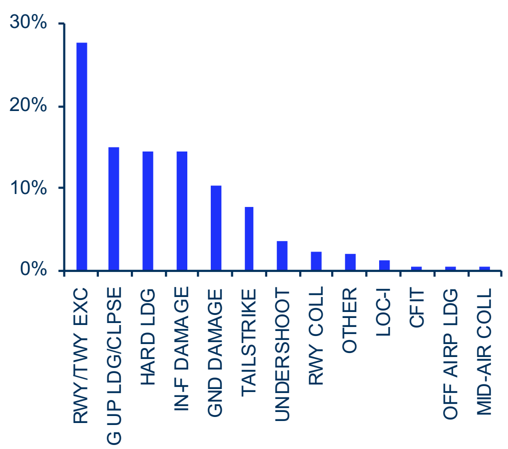
Accident Rate*	2015-2019
IATA Member	0.94
Fatality Risk**	–
Fatal	–
Hull Losses	0.18

Jet	Turboprop	
1.00	2.22	Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

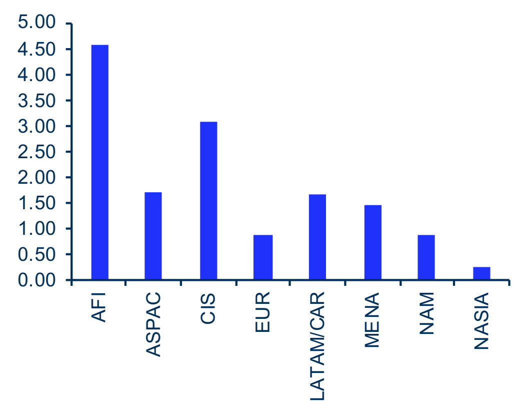
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

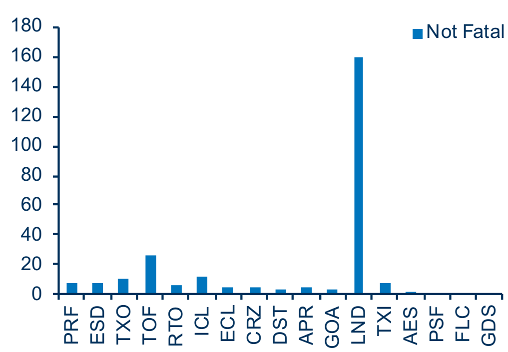
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



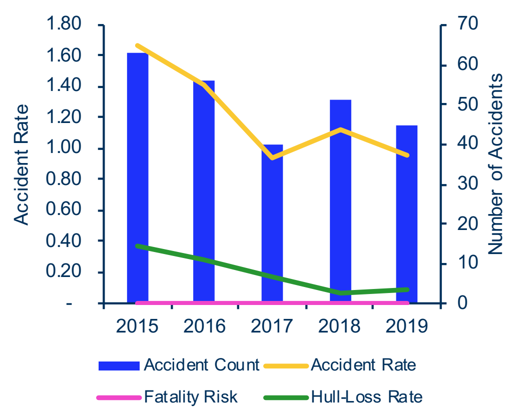
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Nonfatal)



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



2015-2019 IOSA Aircraft Accidents – Accident Count

Number of accidents: 146
Number of fatalities: 613

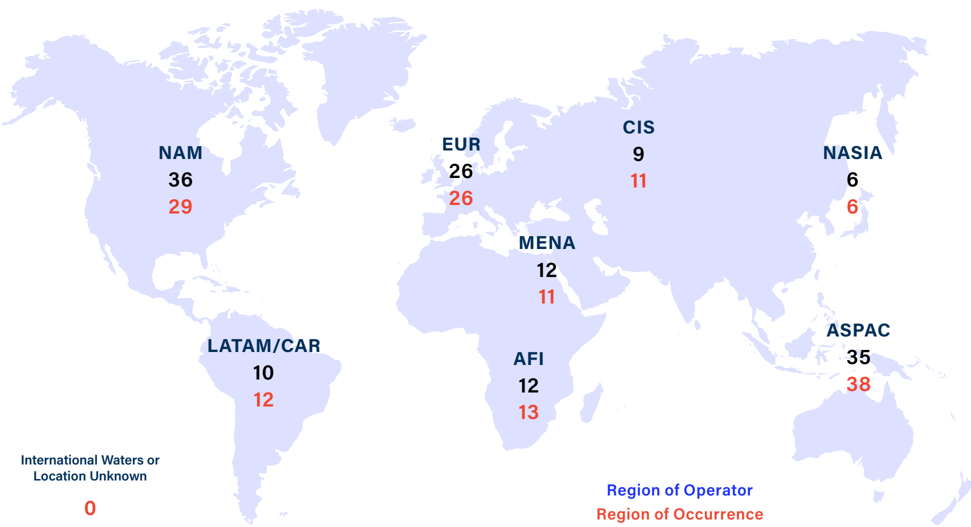
Accident Count % of Total	2015-2019
IATA Member	79%
Full-Loss Equivalents	6%
Fatal	7%
Hull Losses	18%

Passenger	Cargo	Ferry	Jet	Turboprop
96%	4%	0%	85%	15%

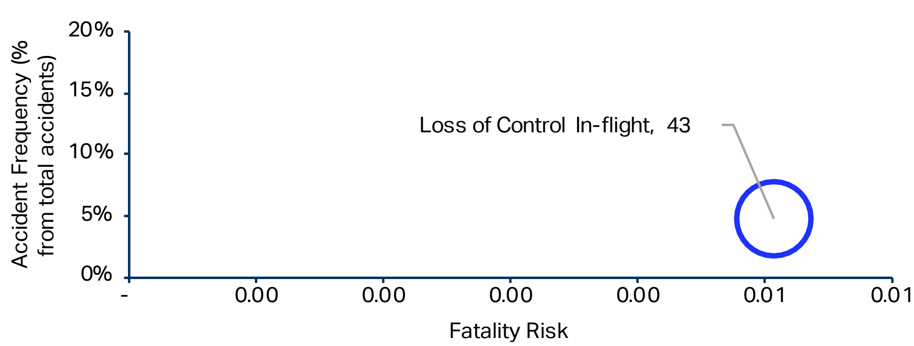
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Regulatory Oversight:
26%

Threats

Meteorology:
34%

Flight Crew Errors

Manual Handling/Flight Controls:
39%

Undesired Aircraft State

Vertical/Lateral/Speed Deviation:
28%

Countermeasure

Overall Crew Performance:
26%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

2015-2019 IOSA Aircraft Accidents – Accident Rate*

Accident rate*: 1.00

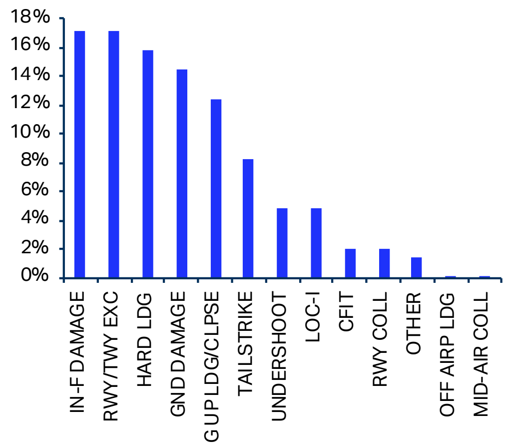
Accident Rate*	2015-2019
IATA Member	1.02
Fatality Risk**	0.06
Fatal	0.07
Hull Losses	0.18

Jet	Turboprop	
0.93	1.79	Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

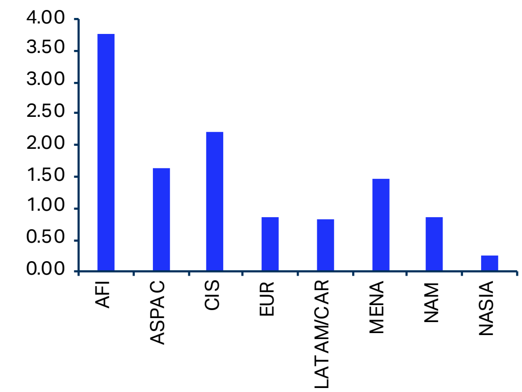
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

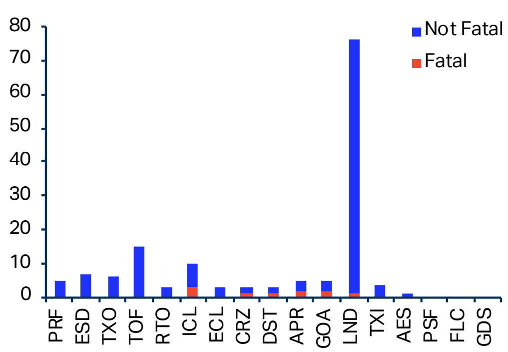
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



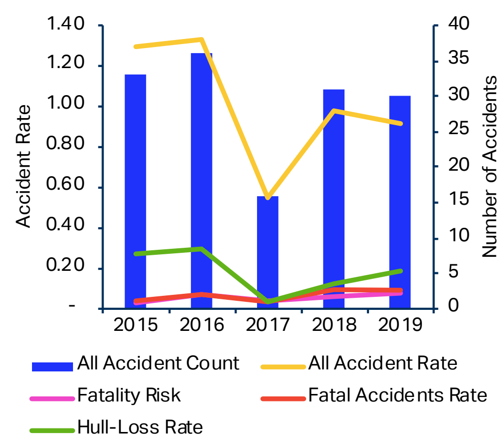
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



2015-2019 Non-IOSA Aircraft Accidents – Accident Count

Number of accidents: 146
Number of fatalities: 503

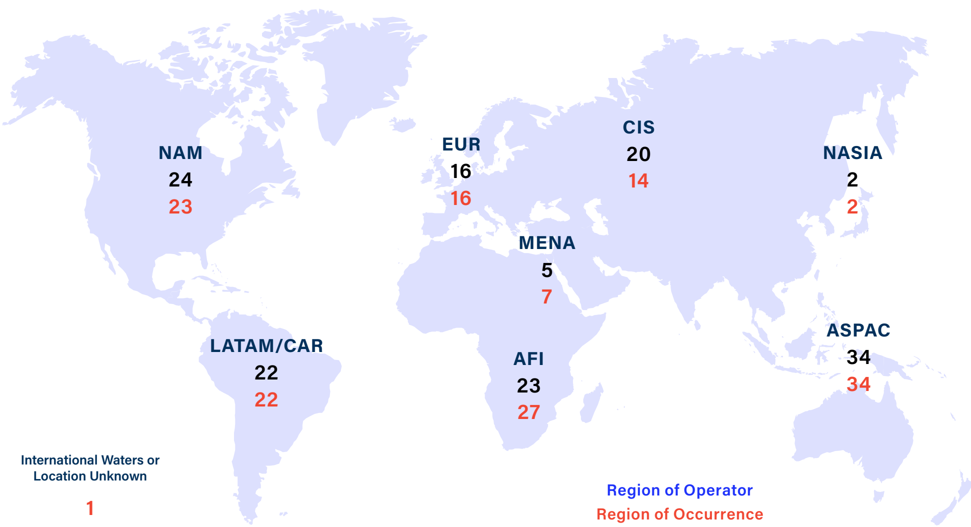
Accident Count % of Total	2015-2019
IATA Member	0%
Full-Loss Equivalents	13%
Fatal	18%
Hull Losses	32%

Passenger	Cargo	Ferry	Jet	Turboprop
68%	31%	1%	47%	53%

Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Top Primary Contributing factors

Latent Conditions

Safety Management and Regulatory Oversight:
39%

Threats

Meteorology:
37%

Flight Crew Errors

Manual Handling/Flight Controls:
39%

Undesired Aircraft State

Long/floated/bounced/firm/off-center/crabbed landing:
24%

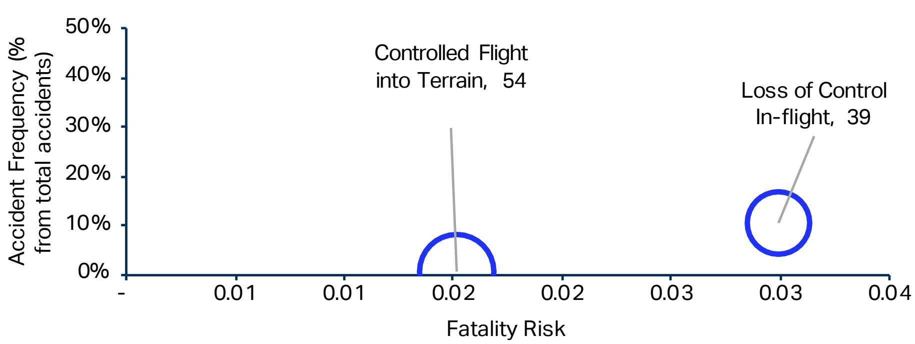
Countermeasure

Overall Crew Performance:
28%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

2015-2019 Non-IOSA Aircraft Accidents – Accident Rate*

Accident rate*: 2.21

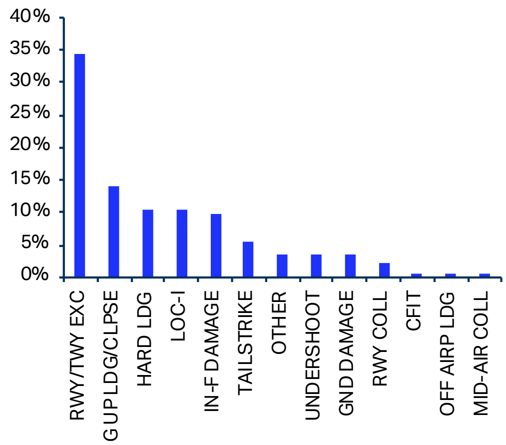
Accident Rate*	2015-2019
IATA Member	-
Fatality Risk**	0.28
Fatal	0.41
Hull Losses	0.71

Jet	Turboprop	
1.58	3.45	Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

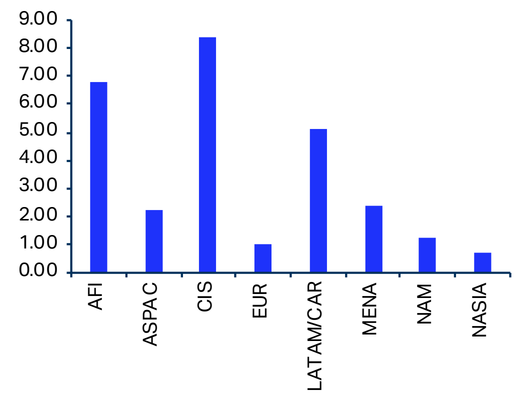
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

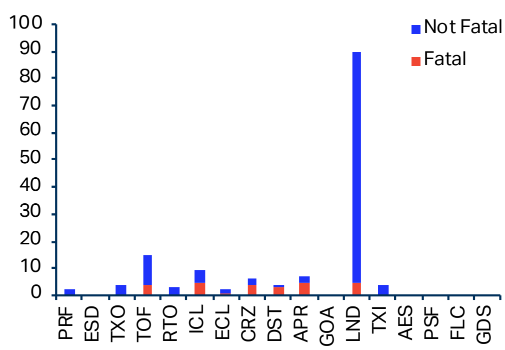
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



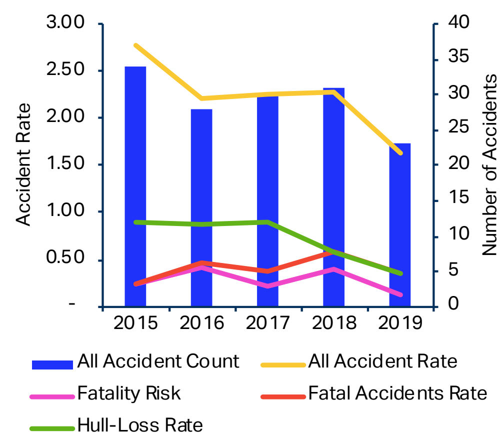
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Controlled Flight into Terrain – Accident Count

2019	Number of accidents: 0	Number of fatalities: 0
2015-2019	Number of accidents: 4	Number of fatalities: 124

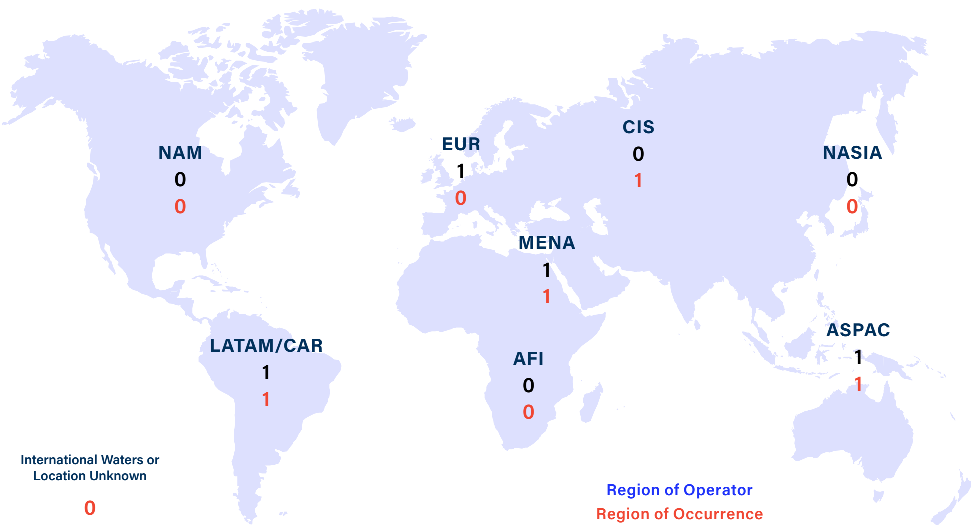
Accident Count % of Total	2019	'15-'19
IATA Member	0%	25%
Full-Loss Equivalents	0%	75%
Fatal	0%	75%
Hull Losses	0%	75%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	0%	0%	0%	0%	0%
2015-2019	75%	25%	0%	25%	75%

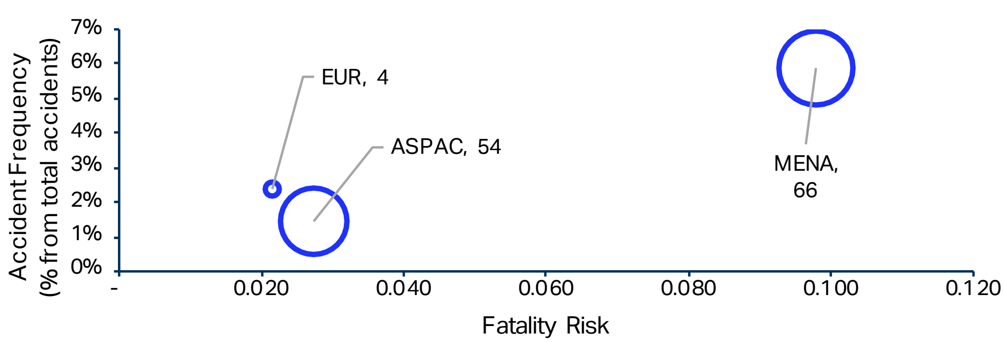
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Regulatory Oversight:
100%

Threats

Meteorology, Poor visibility / IMC and Lack of visual reference:
75%

Flight Crew Errors

SOP Adherence / SOP Cross-verification:
100%

Undesired Aircraft State

Vertical / Lateral / Speed Deviation and Unnecessary weather penetration:
50%

Countermeasure

Overall Crew Performance, In-flight decision-making/ contingency management, and Monitor/Cross-check:
75%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Controlled Flight into Terrain – Accident Rate*

2019 Accident rate: –

2015-2019 Accident rate: 0.02

Accident Rate*	2019	'15-'19
IATA Member	–	0.01
Fatality Risk**	–	0.01
Fatal	–	0.01
Hull Losses	–	0.01

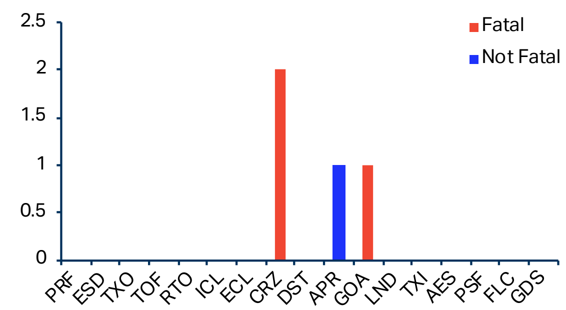
	Jet	Turboprop
2019	–	–
2015-2019	0.01	0.09

Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

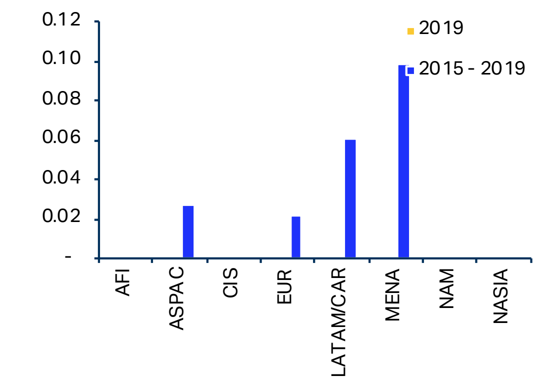
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



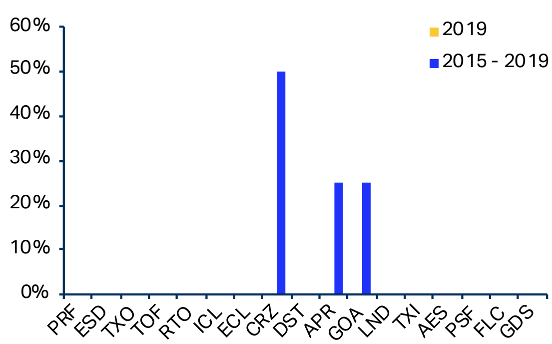
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



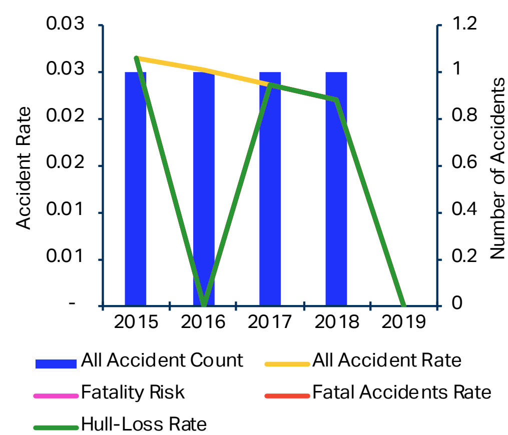
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Note: The fatal accident rate, fatality risk, and hull loss rate share the same value.

Loss of Control – In-flight – Accident Count

2019	Number of accidents: 4	Number of fatalities: 191
2015-2019	Number of accidents: 22	Number of fatalities: 780

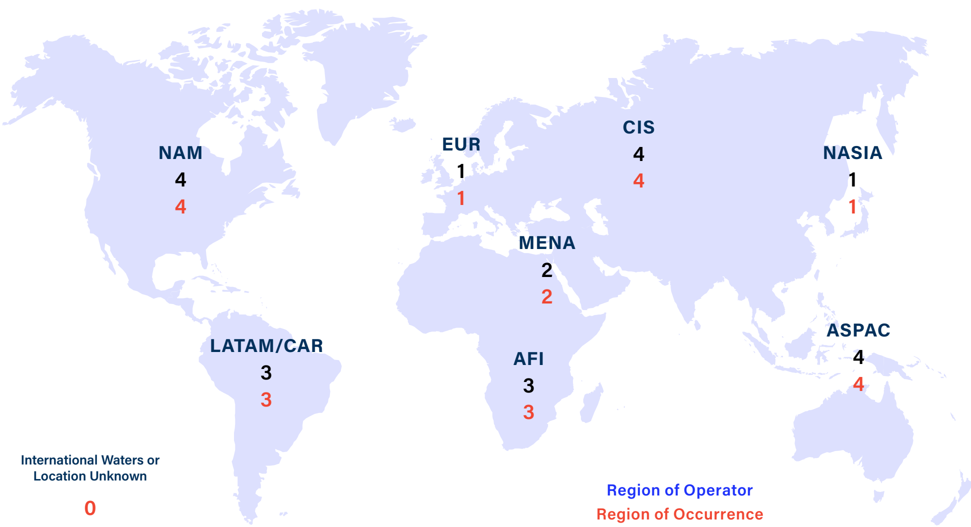
Accident Count % of Total	2019	'15-'19
IATA Member	50%	27%
Full-Loss Equivalents	78%	65%
Fatal	100%	86%
Hull Losses	100%	95%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	75%	25%	0%	75%	25%
2015-2019	64%	36%	0%	50%	50%

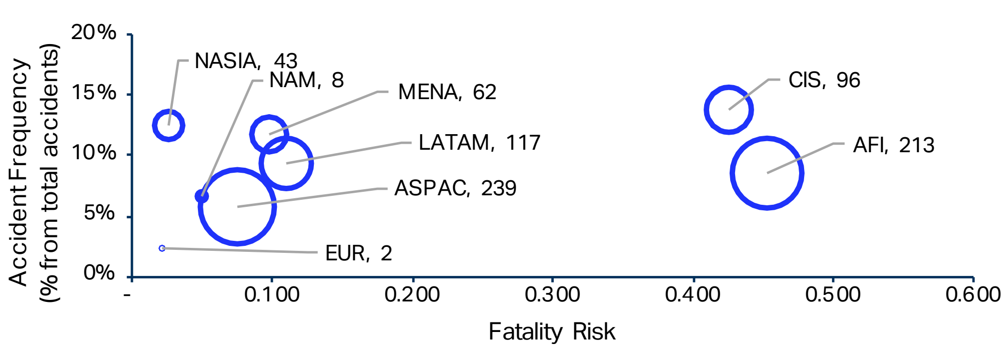
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Flight Operations:
55%

Threats

Meteorology:
45%

Flight Crew Errors

Manual Handling/ Flight Controls and SOP Adherence /SOP Cross-verification:
50%

Undesired Aircraft State

Operation Outside Aircraft Limitations:
40%

Countermeasure

Overall Crew Performance and Monitor / Cross-check:
50%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Loss of Control – In-flight – Accident Rate*

2019	Accident rate: 0.09
2015-2019	Accident rate: 0.10

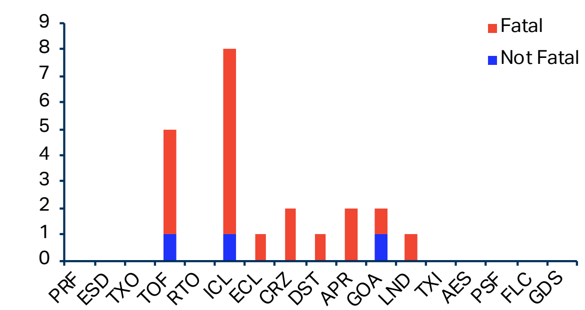
Accident Rate*	2019	'15-'19
IATA Member	0.08	0.05
Fatality Risk**	0.07	0.07
Fatal	0.09	0.09
Hull Losses	0.09	0.10

	Jet	Turboprop	
2019	0.08	0.14	Accident rates for Passenger, Cargo and Ferry are not available.
2015-2019	0.06	0.32	

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

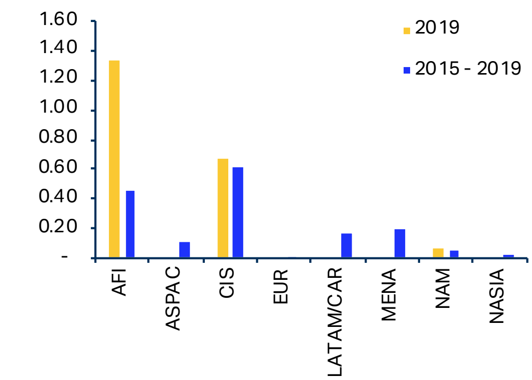
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



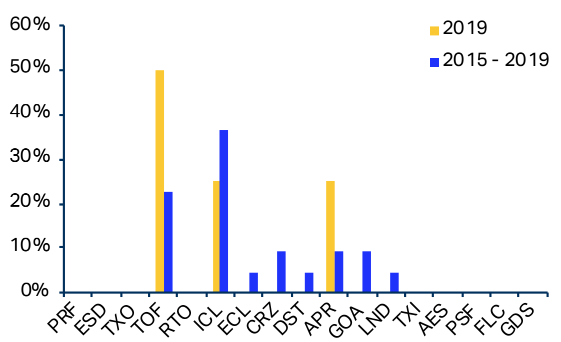
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



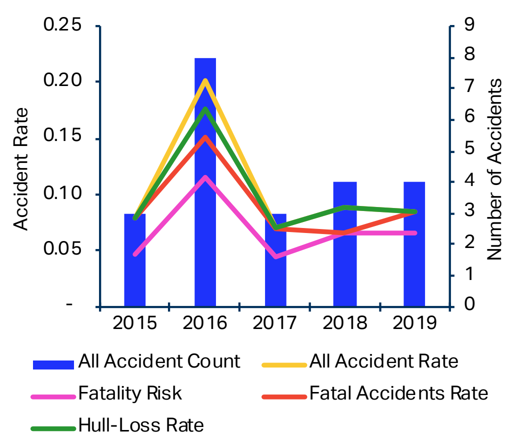
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



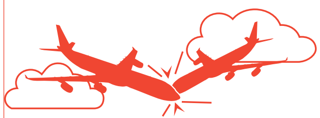
Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Mid-Air Collision – Accident Count

2019	Number of accidents: 0	Number of fatalities: 0
2015-2019	Number of accidents: 1	Number of fatalities: 0



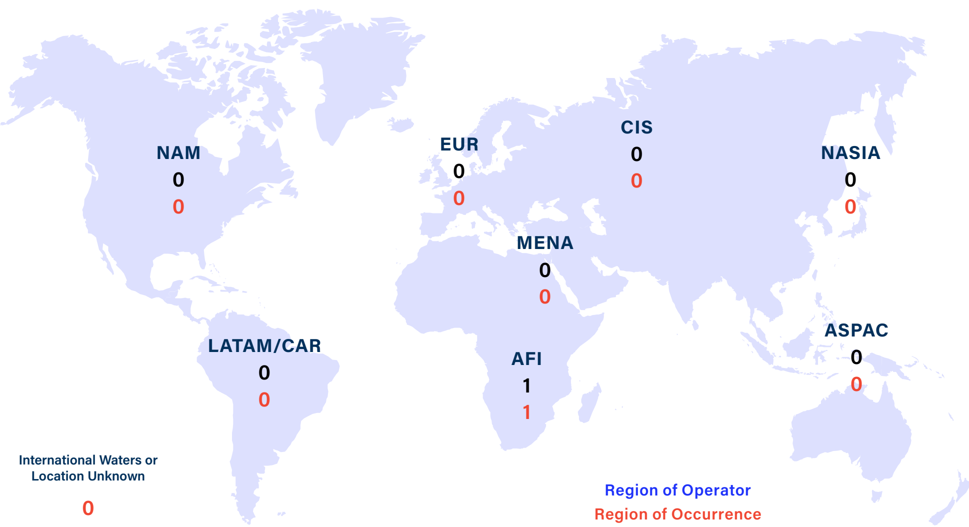
Accident Count % of Total	2019	'15-'19
IATA Member	0%	0%
Full-Loss Equivalents	0%	0%
Fatal	0%	0%
Hull Losses	0%	0%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	0%	0%	0%	0%	0%
2015-2019	100%	0%	0%	100%	0%

Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Note: This report only considers fatalities on board of commercial revenue flights. However, it is important to highlight that in 2015 a mid-air collision involving a commercial jet and a noncommercial aircraft (HS-125 ambulance configuration) resulted in the crash and death of all on board of the HS-125. The B737 suffered substantial damage.

Accident Category Frequency and Fatality Risk (2015-2019)

The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

At least three accidents required to display classification

Threats

At least three accidents required to display classification

Flight Crew Errors

At least three accidents required to display classification

Undesired Aircraft State

At least three accidents required to display classification

Countermeasure

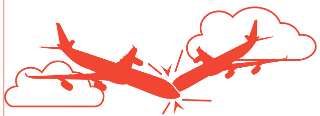
At least three accidents required to display classification

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Mid-Air Collision – Accident Rate*

2019 Accident rate: –
2015-2019 Accident rate: 0.00



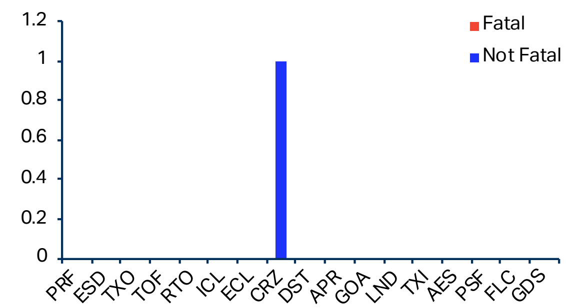
Accident Rate*	2019	'15-'19
IATA Member	-	-
Fatality Risk**	-	-
Fatal	-	-
Hull Losses	-	-

	Jet	Turboprop	
2019	–	–	Accident rates for Passenger, Cargo and Ferry are not available.
2015-2019	0.01	–	

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

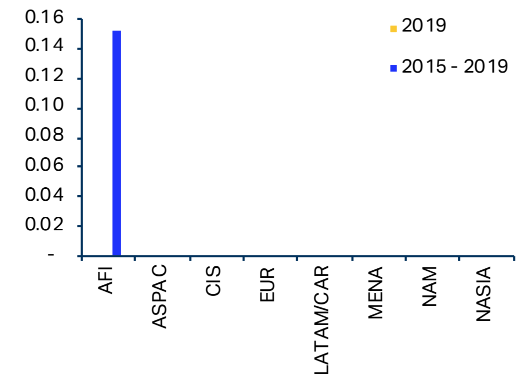
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



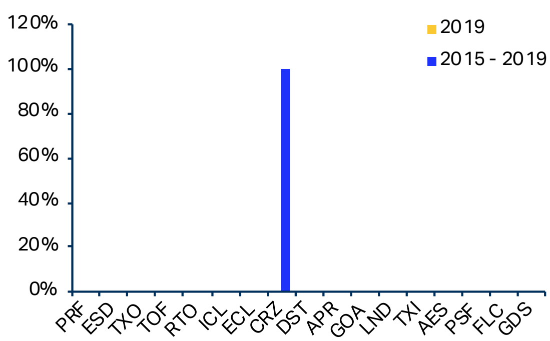
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



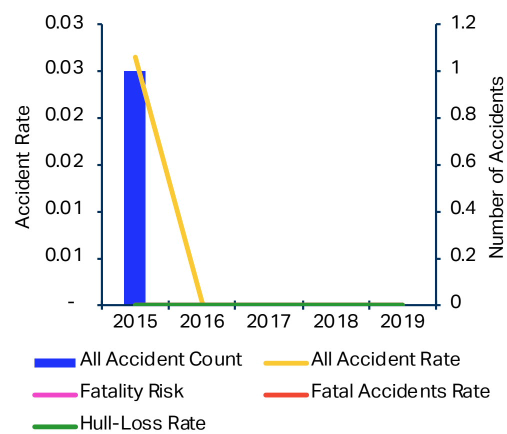
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Runway/Taxiway Excursion – Accident Count

2019	Number of accidents: 17	Number of fatalities: 3
2015-2019	Number of accidents: 74	Number of fatalities: 55

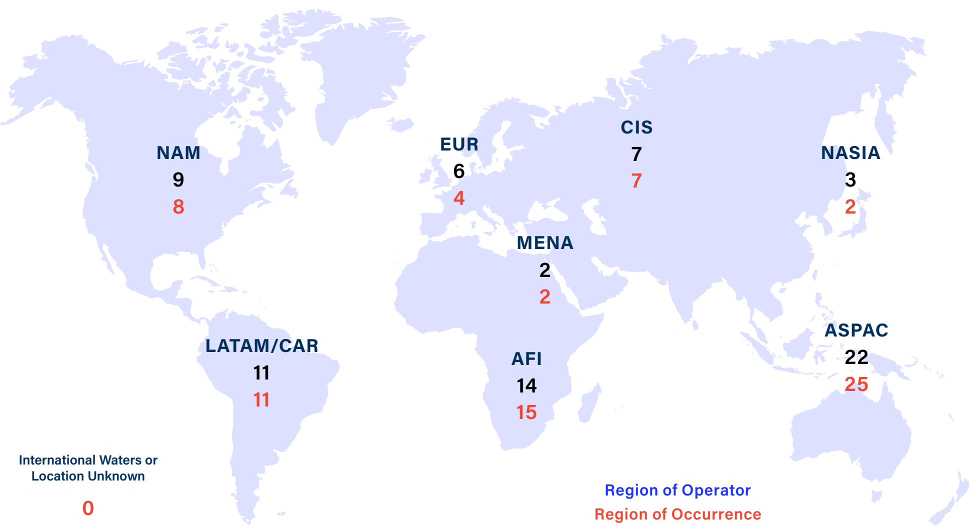
Accident Count % of Total	2019	'15-'19
IATA Member	29%	26%
Full-Loss Equivalents	0%	1%
Fatal	12%	5%
Hull Losses	18%	26%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	100%	0%	0%	35%	65%
2015-2019	80%	20%	0%	61%	39%

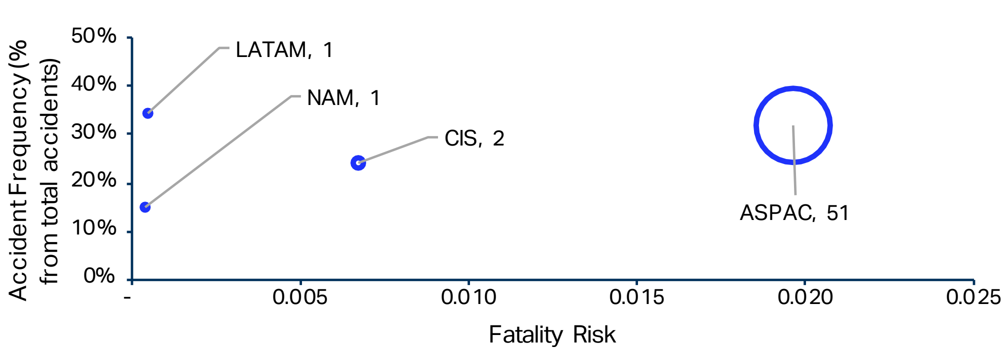
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Safety Management:
41%

Threats

Meteorology:
56%

Flight Crew Errors

Manual Handling/Flight Controls:
48%

Undesired Aircraft State

Long/floated/bounced/firm/off-center/crabbed landing:
40%

Countermeasure

Overall Crew Performance:
37%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Runway/Taxiway Excursion – Accident Rate*

2019 Accident rate: 0.36
2015-2019 Accident rate: 0.35

Accident Rate*	2019	'15-'19
IATA Member	0.20	0.17
Fatality Risk**	0.00	0.00
Fatal	0.04	0.02
Hull Losses	0.06	0.09

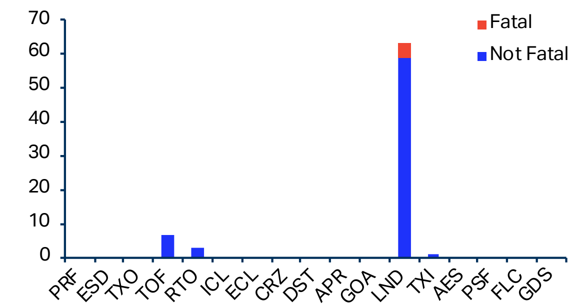
	Jet	Turboprop
2019	0.15	1.51
2015-2019	0.25	0.84

Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

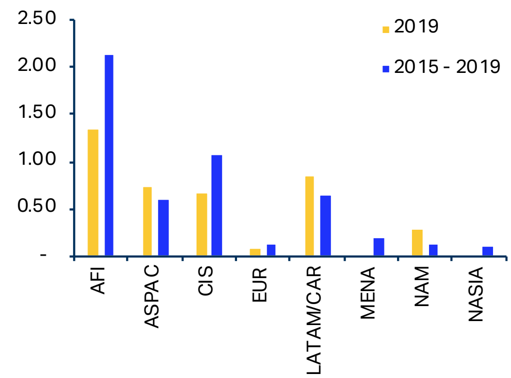
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



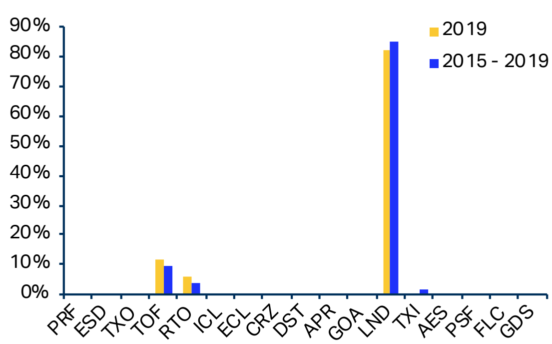
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



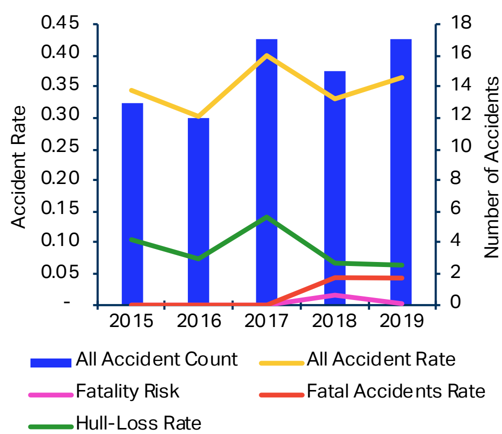
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



In-flight Damage – Accident Count

2019	Number of accidents: 8	Number of fatalities: 0
2015-2019	Number of accidents: 39	Number of fatalities: 2

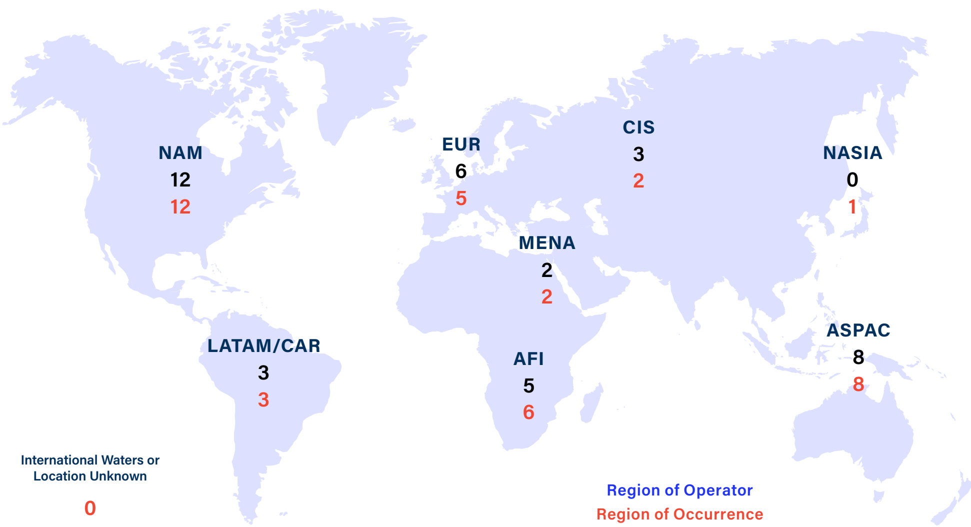
Accident Count % of Total	2019	'15-'19
IATA Member	63%	56%
Full-Loss Equivalents	0%	3%
Fatal	0%	5%
Hull Losses	13%	10%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	100%	0%	0%	63%	38%
2015-2019	87%	13%	0%	82%	18%

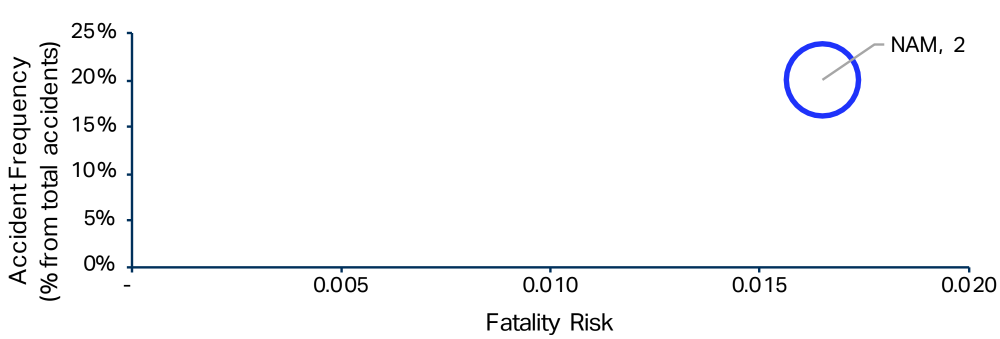
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Regulatory Oversight:
16%

Threats

Aircraft Malfunction:
34%

Flight Crew Errors

SOP Adherence / SOP Cross-verification:
11%

Undesired Aircraft State

Unnecessary Weather Penetration:
13%

Countermeasure

In-flight decision-making/ contingency management, and Evaluation of Plans:
3%

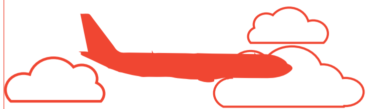
For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

In-flight Damage – Accident Rate*

2019 Accident rate: 0.17

2015-2019 Accident rate: 0.18



Accident Rate*	2019	'15-'19
IATA Member	0.20	0.19
Fatality Risk**	–	0.00
Fatal	–	0.01
Hull Losses	0.02	0.02

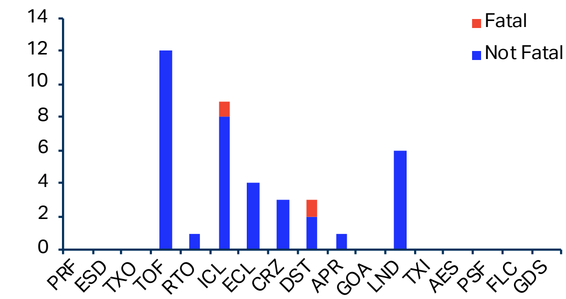
	Jet	Turboprop
2019	0.13	0.41
2015-2019	0.18	0.20

Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

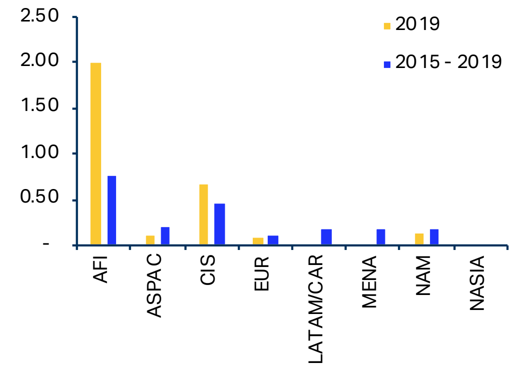
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



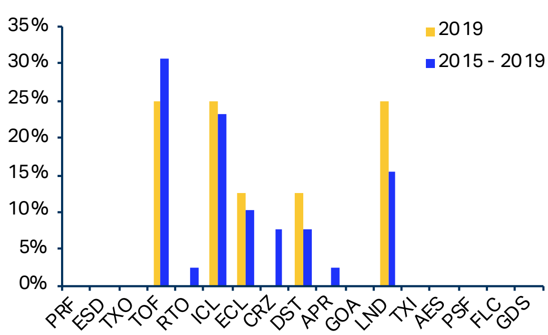
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



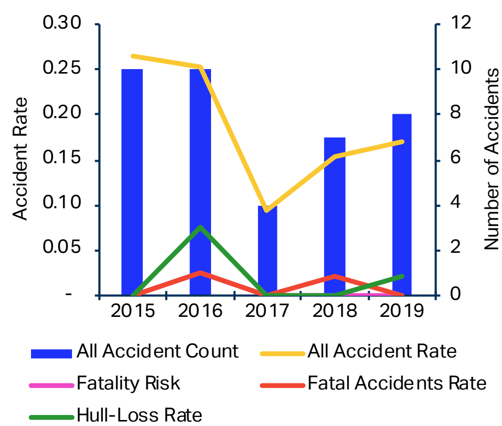
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



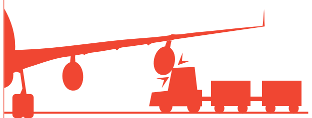
Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Ground Damage – Accident Count

2019	Number of accidents: 4	Number of fatalities: 0
2015-2019	Number of accidents: 26	Number of fatalities: 0



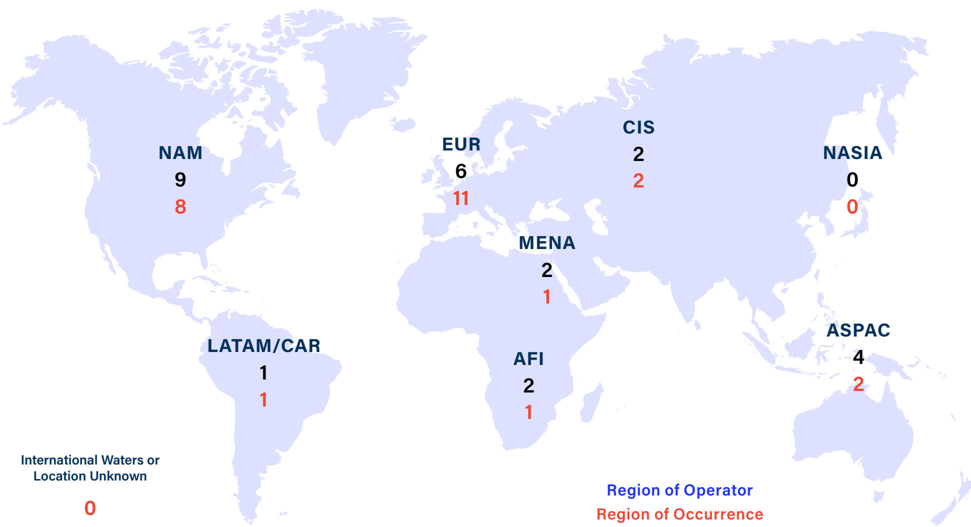
Accident Count % of Total	2019	'15-'19
IATA Member	50%	62%
Full-Loss Equivalents	0%	0%
Fatal	0%	0%
Hull Losses	0%	8%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	100%	0%	0%	75%	25%
2015-2019	96%	4%	0%	92%	8%

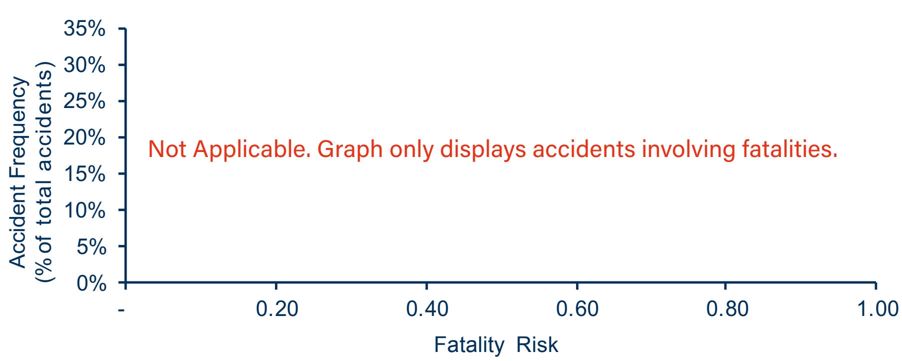
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Ground Operations: SOPs and Checking:
22%

Threats

Ground Events:
30%

Flight Crew Errors

Ground Navigation:
13%

Undesired Aircraft State

Ramp Movements:
17%

Countermeasure

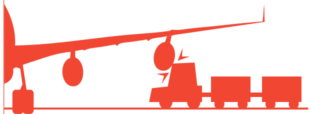
Overall Crew Performance:
13%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Ground Damage – Accident Rate*

2019 Accident rate: 0.09
2015-2019 Accident rate: 0.12



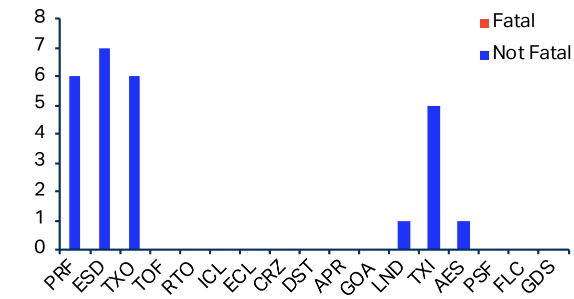
Accident Rate*	2019	'15-'19
IATA Member	0.08	0.14
Fatality Risk**	-	-
Fatal	-	-
Hull Losses	-	0.01

	Jet	Turboprop	
2019	0.08	0.14	Accident rates for Passenger, Cargo and Ferry are not available.
2015-2019	0.14	0.06	

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

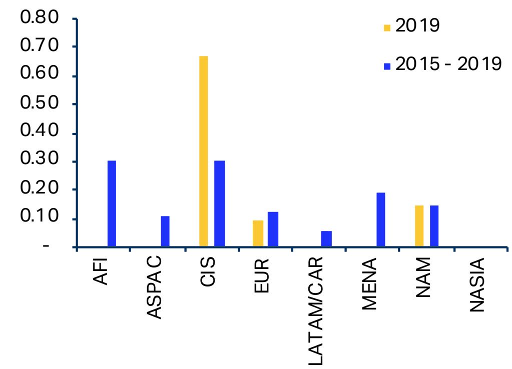
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



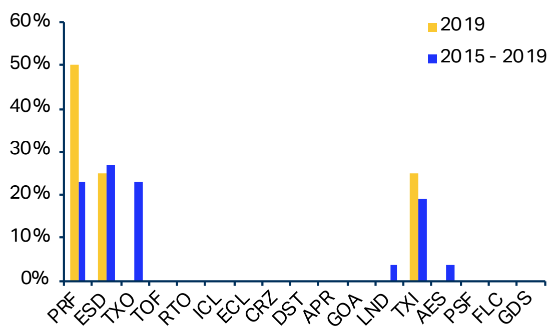
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



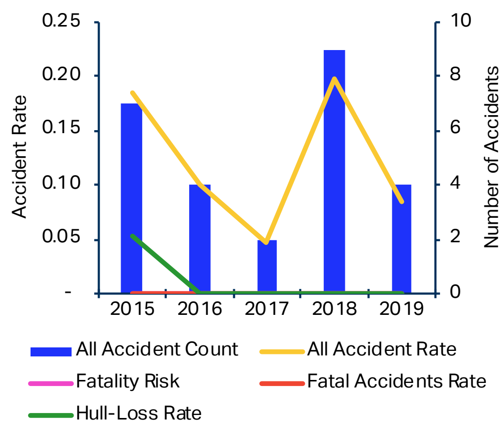
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Undershoot – Accident Count

2019 Number of accidents: 1 Number of fatalities: 0
2015-2019 Number of accidents: 12 Number of fatalities: 7

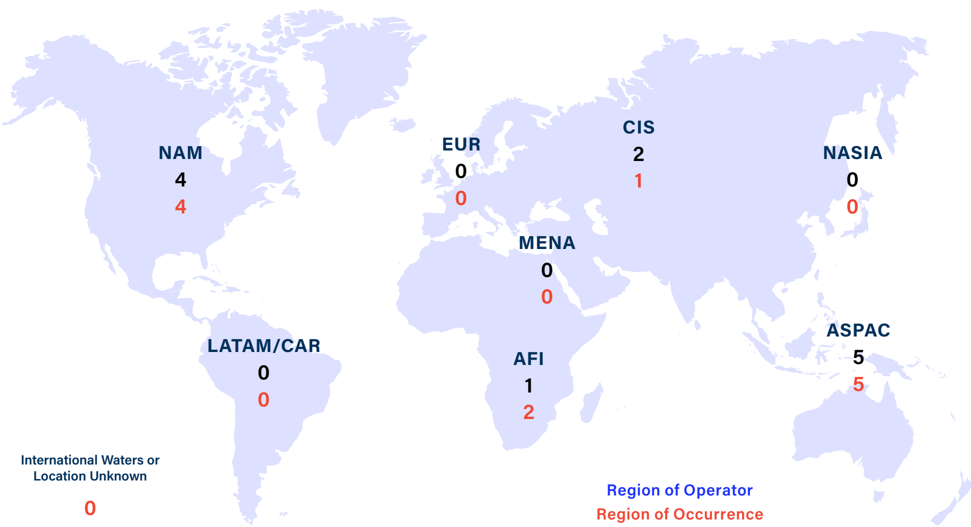
Accident Count % of Total	2019	'15-'19
IATA Member	0%	42%
Full-Loss Equivalents	0%	9%
Fatal	0%	25%
Hull Losses	0%	42%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	100%	0%	0%	100%	0%
2015-2019	67%	33%	0%	58%	42%

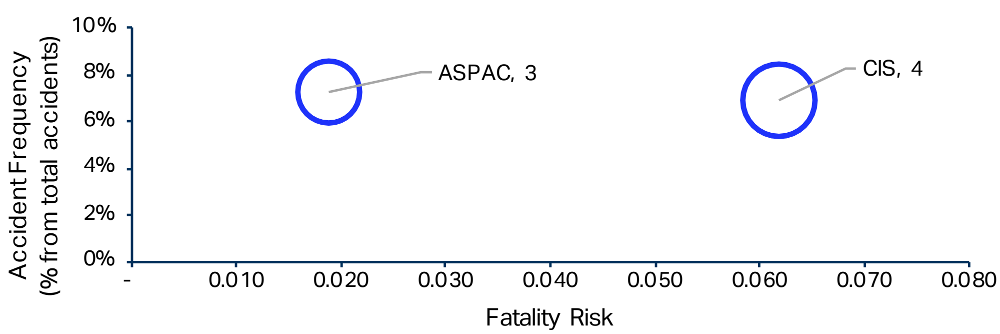
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Regulatory Oversight:
45%

Threats

Meteorology:
73%

Flight Crew Errors

Manual Handling/Flight Controls and SOP Adherence/SOP Cross-verification:
45%

Undesired Aircraft State

Vertical/Lateral/Speed Deviation:
55%

Countermeasure

Overall Crew Performance:
36%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Undershoot – Accident Rate*

2019 Accident rate: 0.02
2015-2019 Accident rate: 0.06

Accident Rate*	2019	'15-'19
IATA Member	-	0.04
Fatality Risk**	-	0.01
Fatal	-	0.01
Hull Losses	-	0.02

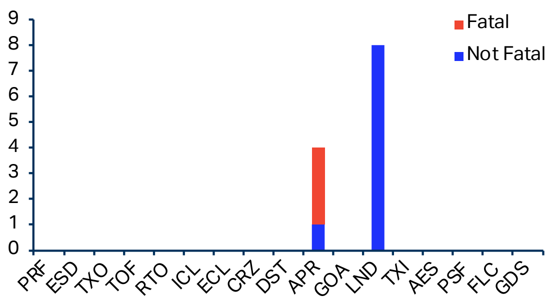
	Jet	Turboprop
2019	0.03	-
2015-2019	0.04	0.14

Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

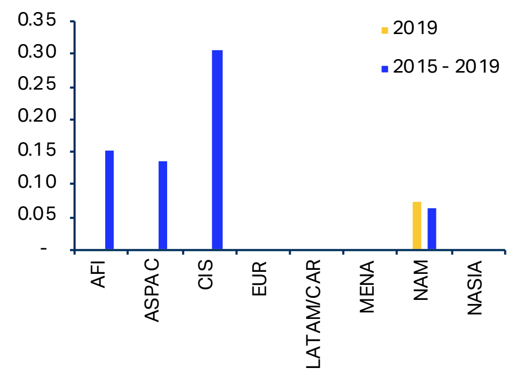
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



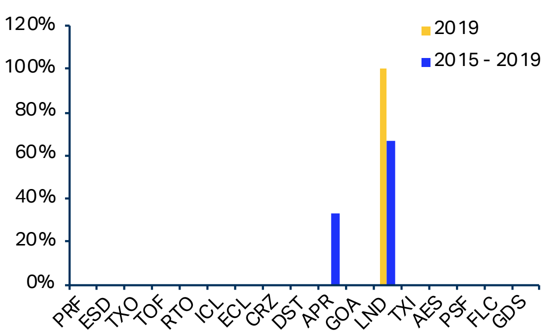
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



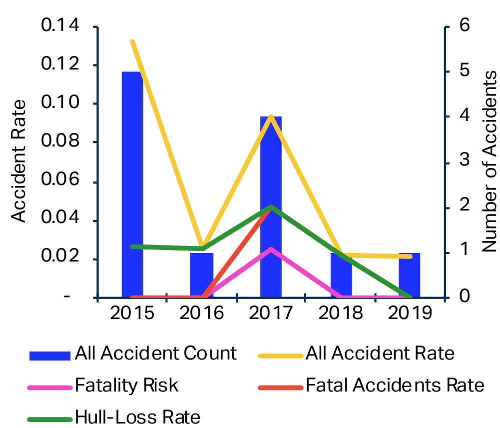
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



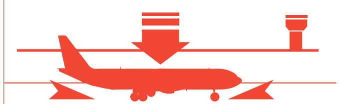
Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Hard Landing – Accident Count

2019	Number of accidents: 4	Number of fatalities: 41
2015-2019	Number of accidents: 38	Number of fatalities: 41



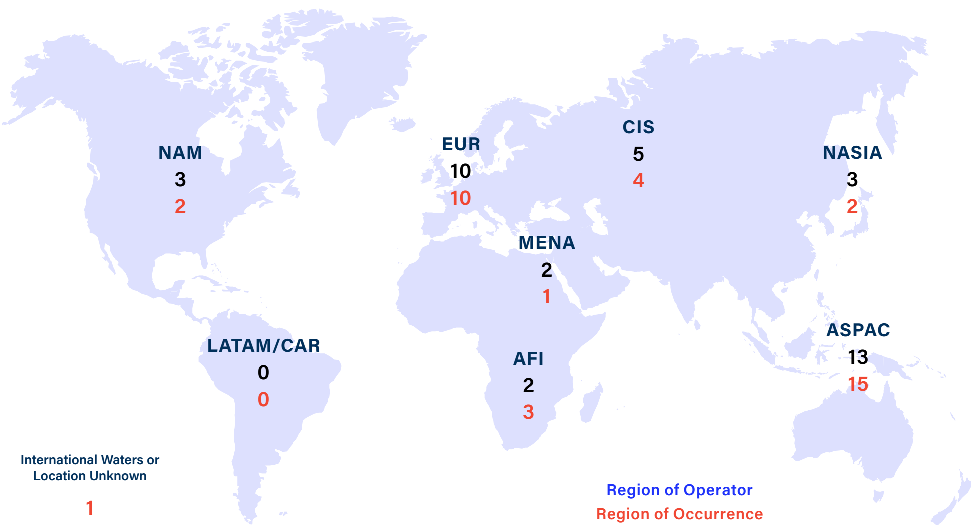
Accident Count % of Total	2019	'15-'19
IATA Member	100%	58%
Full-Loss Equivalents	13%	1%
Fatal	25%	3%
Hull Losses	25%	13%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	100%	0%	0%	100%	0%
2015-2019	87%	13%	0%	74%	26%

Note: the sum may not add to 100% due to rounding

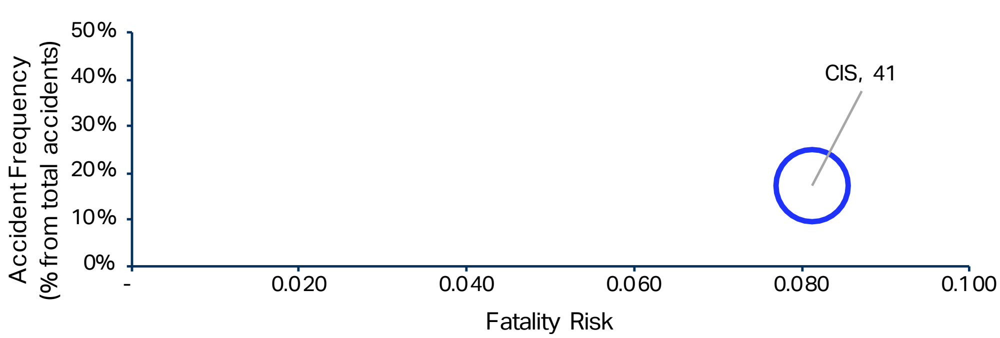
Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Note: An-74 Hard Landing. Location: Barneo Ice Base (International Waters)

Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Flight Operations:
24%

Threats

Meteorology:
42%

Flight Crew Errors

Manual Handling/Flight Controls:
71%

Undesired Aircraft State

Long/floated/bounced/firm/off-center/crabbed landing:
45%

Countermeasure

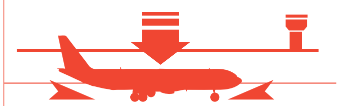
Overall Crew Performance:
37%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Hard Landing – Accident Rate*

2019 Accident rate: 0.09
2015-2019 Accident rate: 0.18



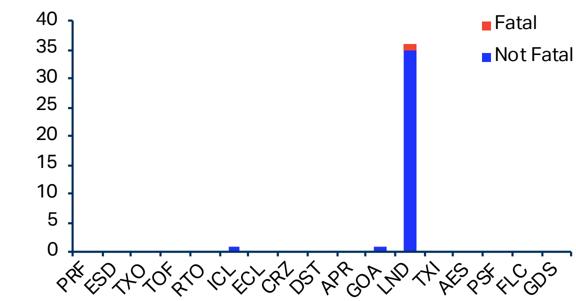
Accident Rate*	2019	'15-'19
IATA Member	0.16	0.19
Fatality Risk**	0.01	0.00
Fatal	0.02	0.00
Hull Losses	0.02	0.02

	Jet	Turboprop	
2019	0.10	–	Accident rates for Passenger, Cargo and Ferry are not available.
2015-2019	0.16	0.29	

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

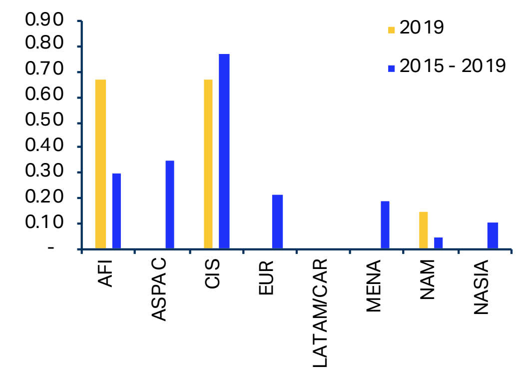
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



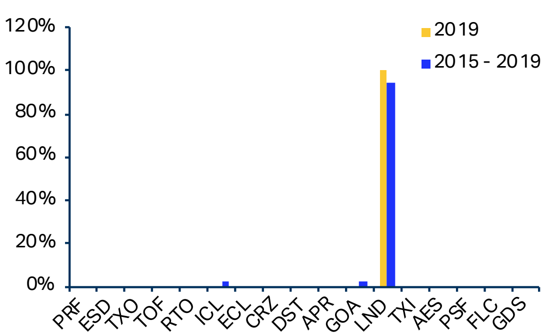
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



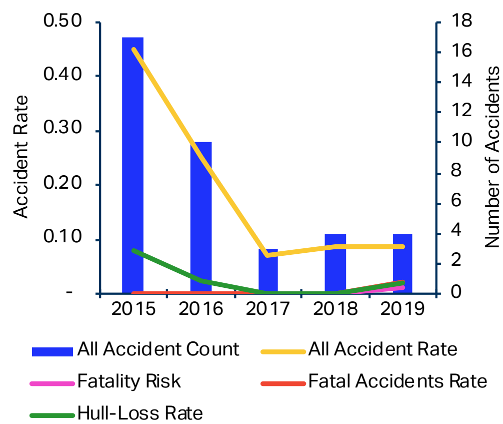
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Gear-up Landing/Gear Collapse – Accident Count

2019	Number of accidents: 6	Number of fatalities: 0
2015-2019	Number of accidents: 38	Number of fatalities: 0

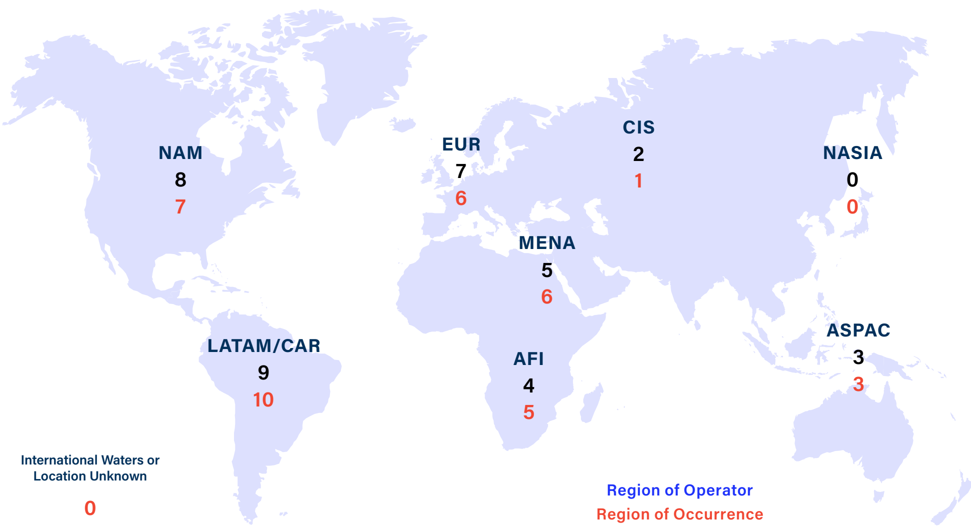
Accident Count % of Total	2019	'15-'19
IATA Member	33%	32%
Full-Loss Equivalents	0%	0%
Fatal	0%	0%
Hull Losses	0%	18%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	67%	33%	0%	83%	17%
2015-2019	82%	16%	3%	61%	39%

Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)

The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Maintenance Operations:
39%

Threats

Aircraft Malfunction:
78%

Flight Crew Errors

Abnormal Checklist and SOP Adherence / SOP Cross-verification:
6%

Undesired Aircraft State

Landing Gear:
6%

Countermeasure

In-flight decision-making/ contingency management:
6%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Gear-up Landing/Gear Collapse – Accident Rate*

2019 Accident rate: 0.13
2015-2019 Accident rate: 0.18

Accident Rate*	2019	'15-'19
IATA Member	0.08	0.11
Fatality Risk**	-	-
Fatal	-	-
Hull Losses	-	0.03

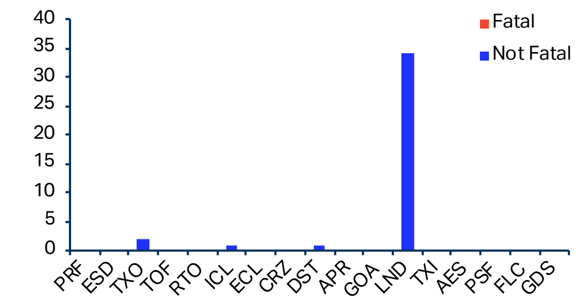
	Jet	Turboprop
2019	0.13	0.14
2015-2019	0.13	0.43

Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

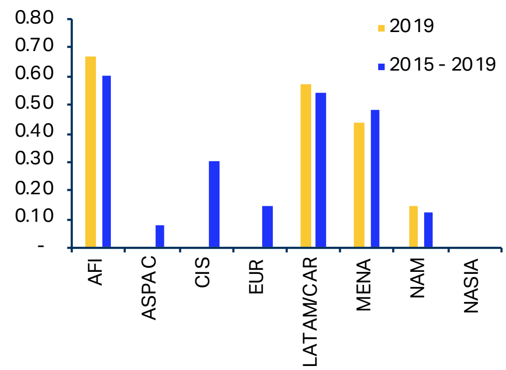
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



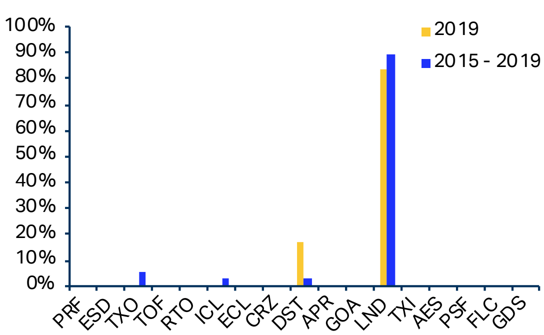
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



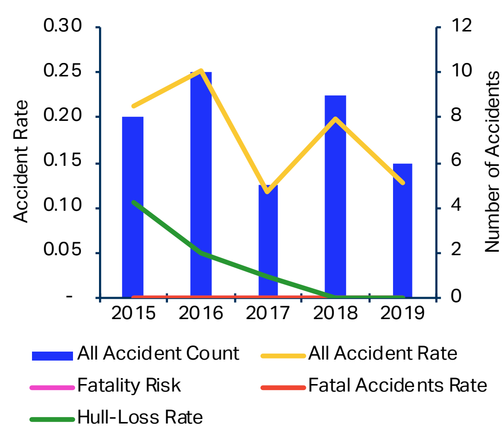
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



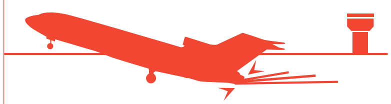
Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Tail Strike – Accident Count

2019	Number of accidents: 5	Number of fatalities: 0
2015-2019	Number of accidents: 20	Number of fatalities: 0



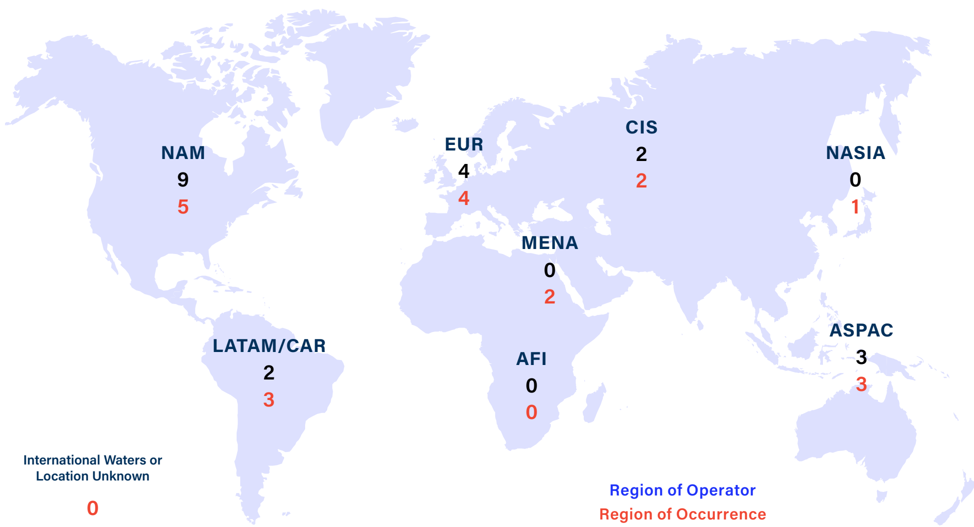
Accident Count % of Total	2019	'15-'19
IATA Member	20%	50%
Full-Loss Equivalents	0%	0%
Fatal	0%	0%
Hull Losses	0%	0%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	100%	0%	0%	60%	40%
2015-2019	95%	5%	0%	80%	20%

Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)

The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Flight Operations:
21%

Threats

Meteorology Wind/ Wind shear/Gusty wind:
26%

Flight Crew Errors

Manual Handling/Flight Controls:
74%

Undesired Aircraft State

Long/floated/bounced/ firm/off-center/crabbed landing:
63%

Countermeasure

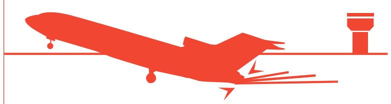
Monitor / Cross-check:
37%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Tail Strike – Accident Rate*

2019 Accident rate: 0.11
2015-2019 Accident rate: 0.09



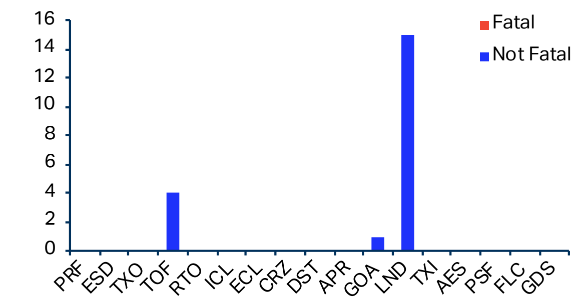
Accident Rate*	2019	'15-'19
IATA Member	0.04	0.09
Fatality Risk**	-	-
Fatal	-	-
Hull Losses	-	-

	Jet	Turboprop	
2019	0.08	0.28	Accident rates for Passenger, Cargo and Ferry are not available.
2015-2019	0.09	0.12	

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

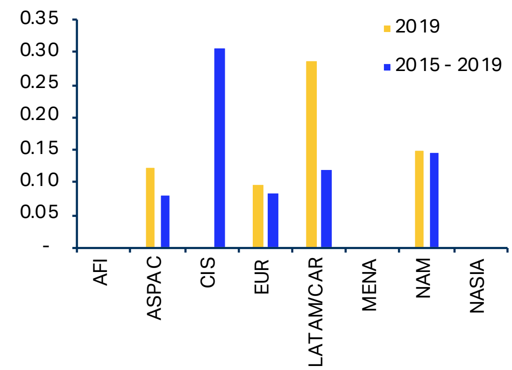
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



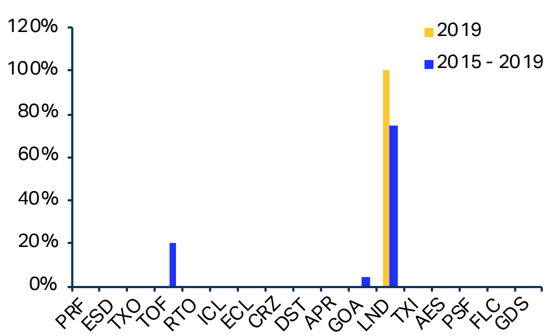
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



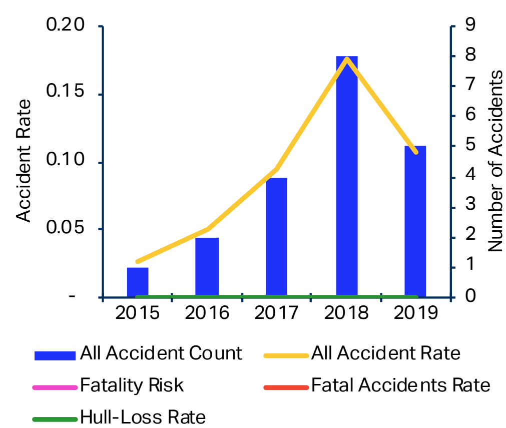
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



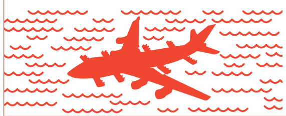
Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Off-Airport Landing/Ditching – Accident Count

2019	Number of accidents: 0	Number of fatalities: 0
2015-2019	Number of accidents: 1	Number of fatalities: 0



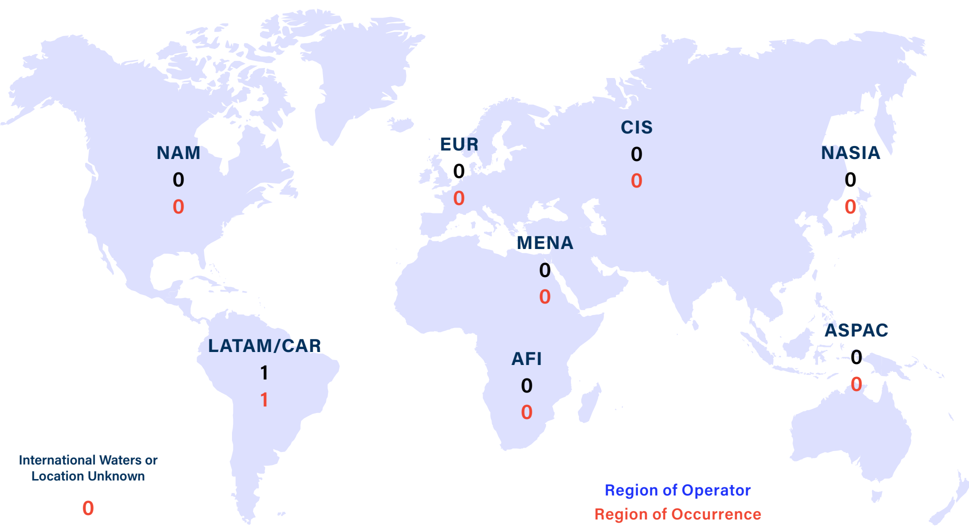
Accident Count % of Total	2019	'15-'19
IATA Member	0%	0%
Full-Loss Equivalents	0%	0%
Fatal	0%	0%
Hull Losses	0%	0%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	0%	0%	0%	0%	0%
2015-2019	0%	100%	0%	0%	100%

Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)

The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

At least three accidents required to display classification

Threats

At least three accidents required to display classification

Flight Crew Errors

At least three accidents required to display classification

Undesired Aircraft State

At least three accidents required to display classification

Countermeasure

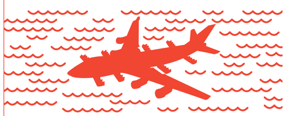
At least three accidents required to display classification

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Off-Airport Landing/Ditching – Accident Rate*

2019 Accident rate: –
2015-2019 Accident rate: 0.00



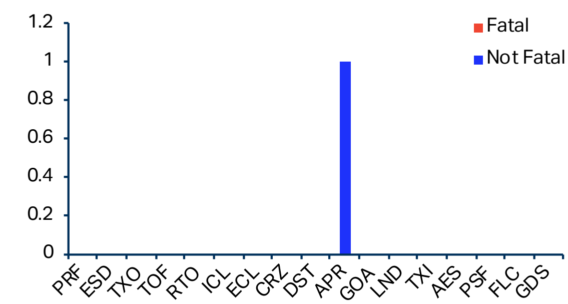
Accident Rate*	2019	'15-'19
IATA Member	–	–
Fatality Risk**	–	–
Fatal	–	–
Hull Losses	–	–

	Jet	Turboprop	
2019	–	–	Accident rates for Passenger, Cargo and Ferry are not available.
2015-2019	0.00	0.03	

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

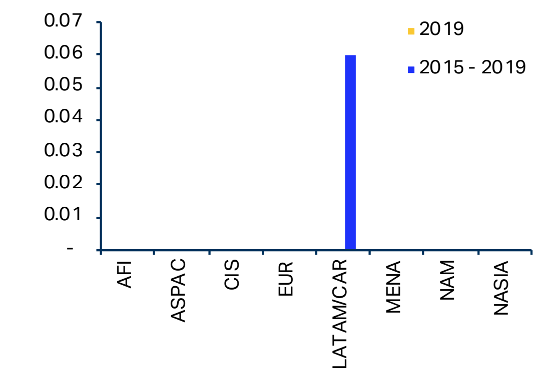
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



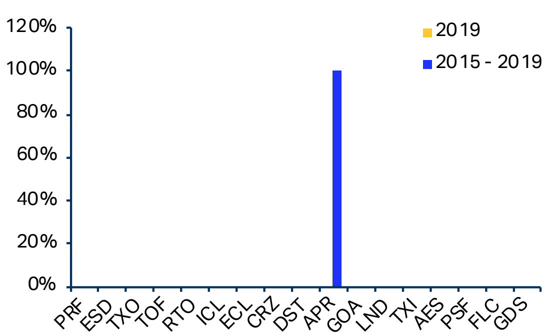
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



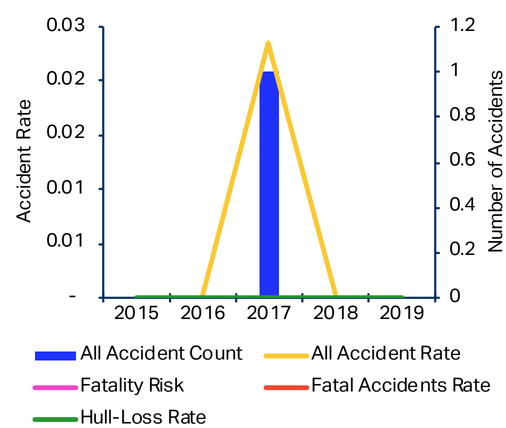
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Runway Collision – Accident Count

2019 Number of accidents: 0 Number of fatalities: 0
2015-2019 Number of accidents: 6 Number of fatalities: 0

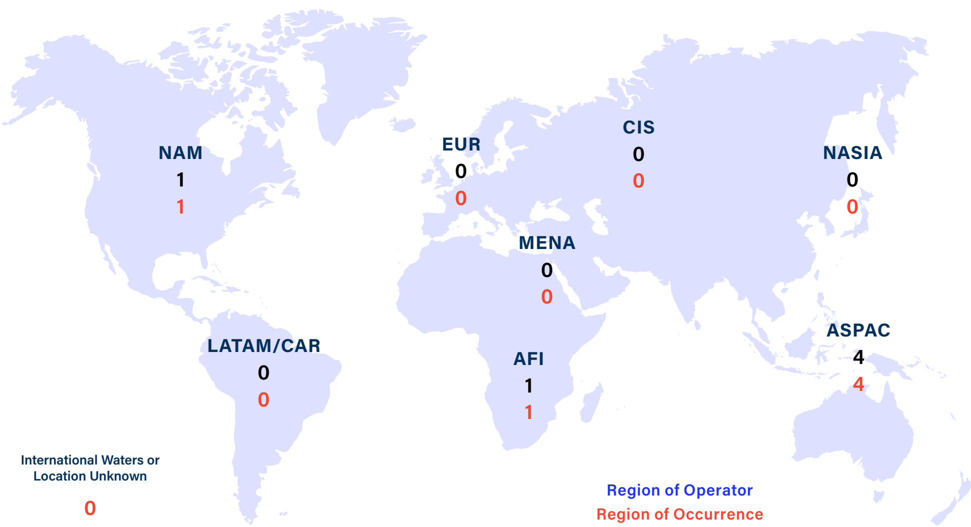
Accident Count % of Total	2019	'15-'19
IATA Member	0%	17%
Full-Loss Equivalents	0%	0%
Fatal	0%	0%
Hull Losses	0%	17%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	0%	0%	0%	0%	0%
2015-2019	100%	0%	0%	33%	67%

Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)

The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Regulatory Oversight:
83%

Threats

Airport Facilities and Air Traffic Services:
50%

Flight Crew Errors

SOP Adherence / SOP Cross-verification, Crew to external communication, Ground navigation, ATC, callouts, and Briefings:
17%

Undesired Aircraft State

Runway / Taxiway Incursion:
33%

Countermeasure

Overall crew performance, Monitor / Cross-check, and Inquiry:
17%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Runway Collision – Accident Rate*

2019	Accident rate: –
2015-2019	Accident rate: 0.03

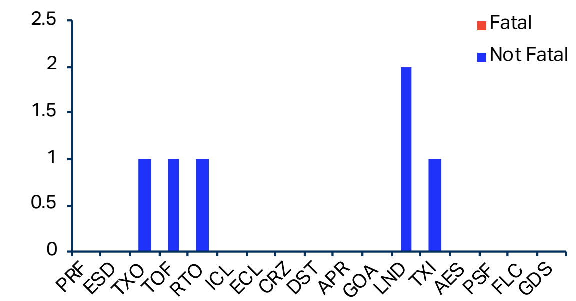
Accident Rate*	2019	'15-'19
IATA Member	–	0.01
Fatality Risk**	–	–
Fatal	–	–
Hull Losses	–	0.00

	Jet	Turboprop	
2019	–	–	Accident rates for Passenger, Cargo and Ferry are not available.
2015-2019	0.01	0.12	

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

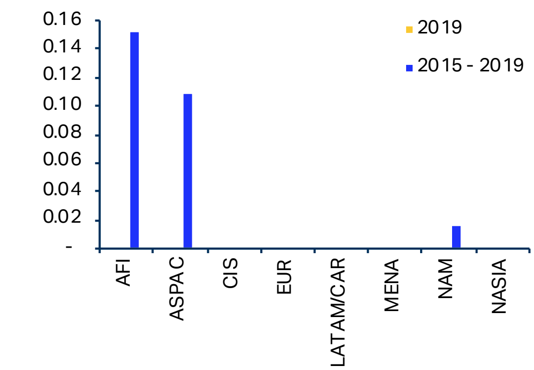
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



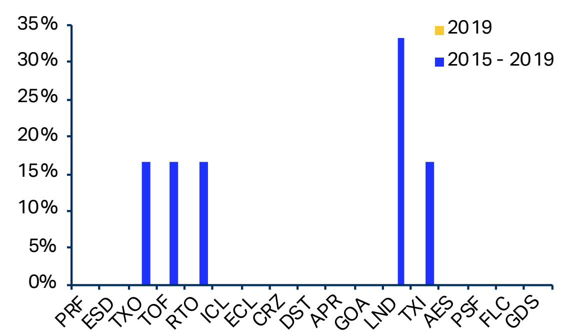
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



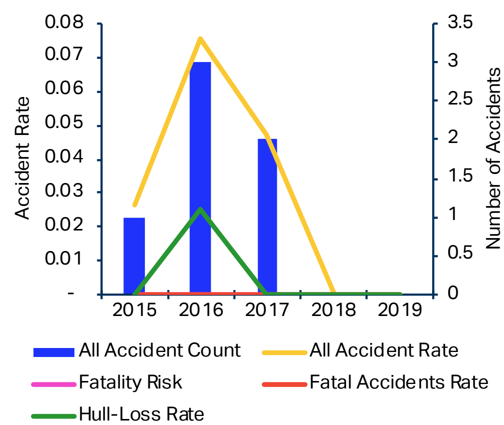
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Jet Aircraft Accidents – Accident Count

2019	Number of accidents:	31	Number of fatalities:	213
2015-2019	Number of accidents:	193	Number of fatalities:	732

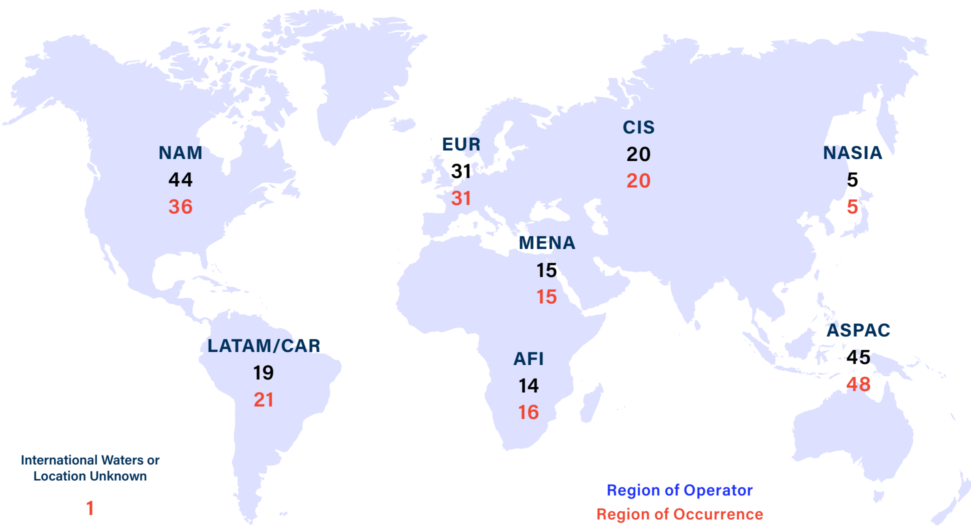
Accident Count % of Total	2019	'15-'19
IATA Member	61%	51%
Full-Loss Equivalents	8%	2%
Fatal	13%	8%
Hull Losses	19%	20%

	Passenger	Cargo	Ferry
2019	90%	10%	0%
2015-2019	88%	12%	0%

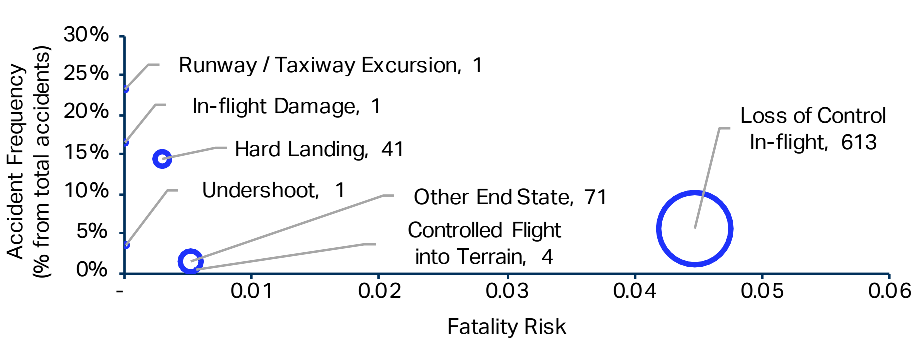
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Safety Management:
31%

Threats

Meteorology:
34%

Flight Crew Errors

Manual Handling/Flight Controls:
40%

Undesired Aircraft State

Long/floated/bounced/firm/off-center/crabbed landing:
26%

Countermeasure

Overall Crew Performance:
27%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Jet Aircraft Accidents – Accident Rate*

2019 Accident rate: 0.78
2015-2019 Accident rate: 1.09

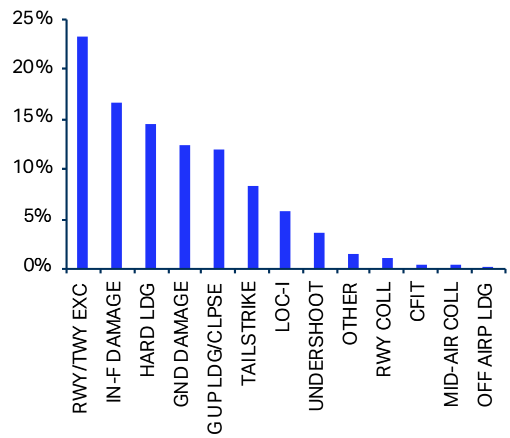
Accident Rate*	2019	'15-'19
IATA Member	0.81	0.94
Fatality Risk**	0.06	0.02
Fatal	0.10	0.08
Hull Losses	0.15	0.22

Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

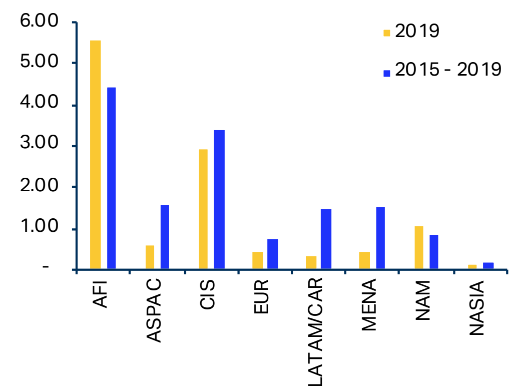
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

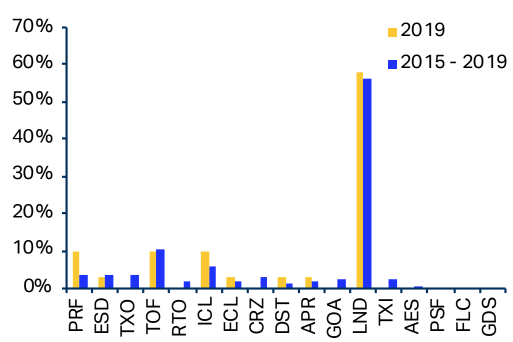
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



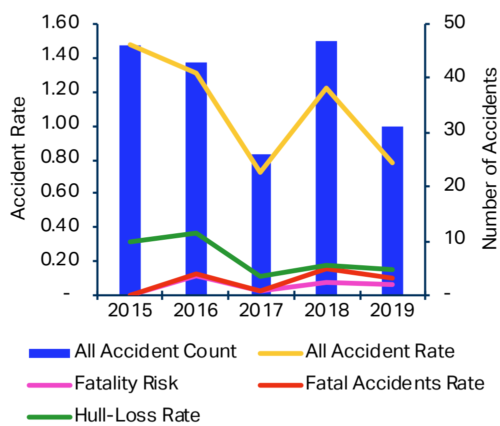
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Turboprop Aircraft Accidents – Accident Count

2019	Number of accidents: 22	Number of fatalities: 27
2015-2019	Number of accidents: 99	Number of fatalities: 384

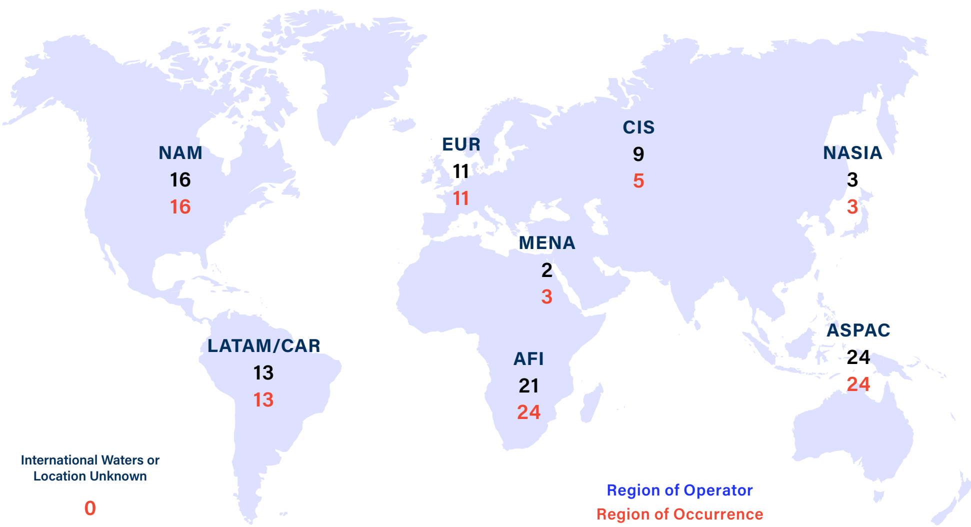
Accident Count % of Total	2019	'15-'19
IATA Member	14%	16%
Full-Loss Equivalents	0%	3%
Fatal	18%	22%
Hull Losses	23%	34%

	Passenger	Cargo	Ferry
2019	91%	9%	0%
2015-2019	70%	28%	2%

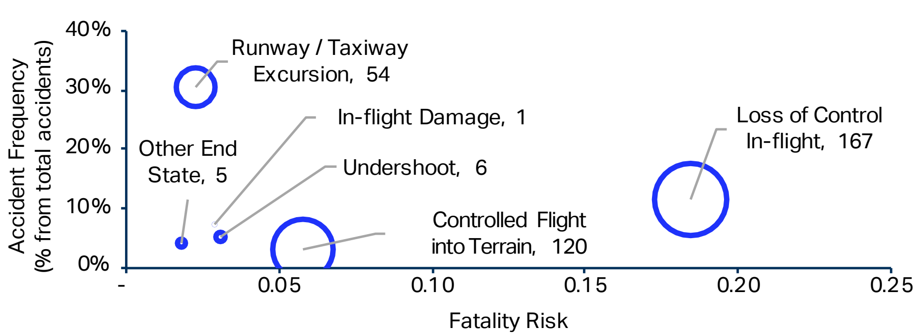
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Regulatory Oversight:
37%

Threats

Meteorology:
39%

Flight Crew Errors

Manual Handling/Flight Controls:
37%

Undesired Aircraft State

Vertical / Lateral / Speed Deviation:
23%

Countermeasure

Overall Crew Performance:
27%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Turboprop Aircraft Accidents – Accident Rate*

2019 Accident rate: 3.03
2015-2019 Accident rate: 2.86

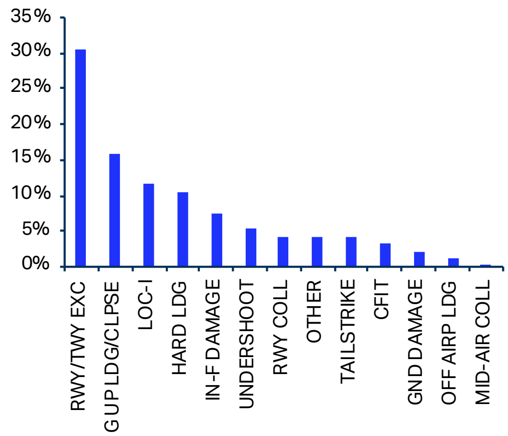
Accident Rate*	2019	'15-'19
IATA Member	1.75	2.06
Fatality Risk**	–	0.08
Fatal	0.55	0.63
Hull Losses	0.69	0.98

Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

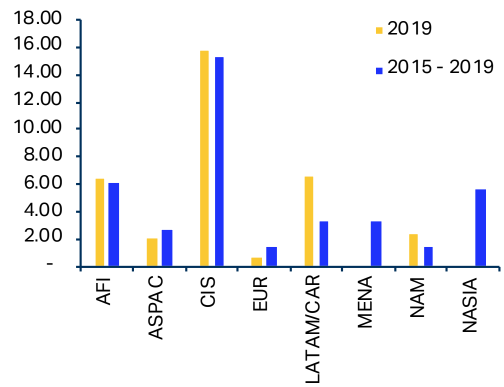
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

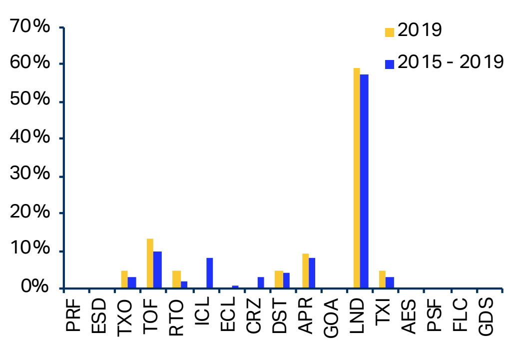
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



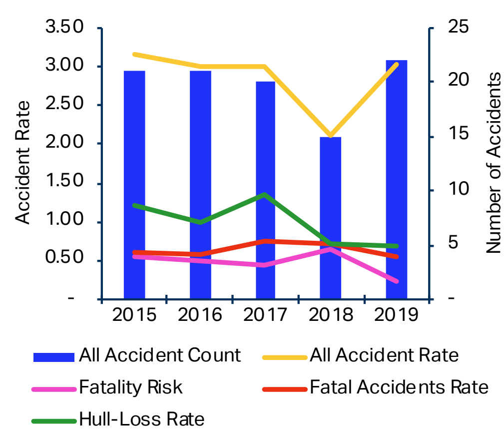
Accidents per Phase of Flight (2015-2019)

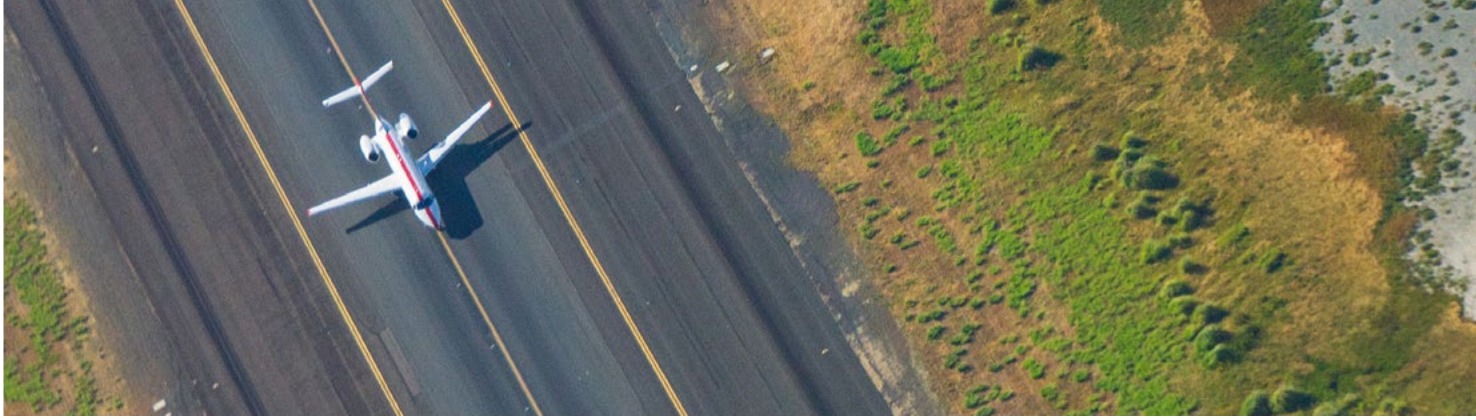
Total Number of Accidents



Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used





5

In-Depth Regional Accident Analysis

Following the same model as the in-depth analysis by accident category presented in Section 4, this section presents an overview of occurrences and their contributing factors broken down by the region of the involved operator(s).

The purpose of this section is to identify issues that operators located in the same region may share, in order to develop adequate prevention strategies.

Note: IATA determines the accident region based on the operator's "home" country as specified in the operator's Air Operator Certificate (AOC).

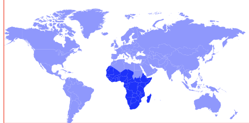
For example, if a Canadian-registered operator has an accident in Europe, this accident is considered a North American accident.

For a complete list of countries assigned per region, please consult Annex 1.

Image courtesy of ATR

Africa Aircraft Accidents – Accident Count

2019	Number of accidents: 9	Number of fatalities: 176
2015-2019	Number of accidents: 35	Number of fatalities: 224



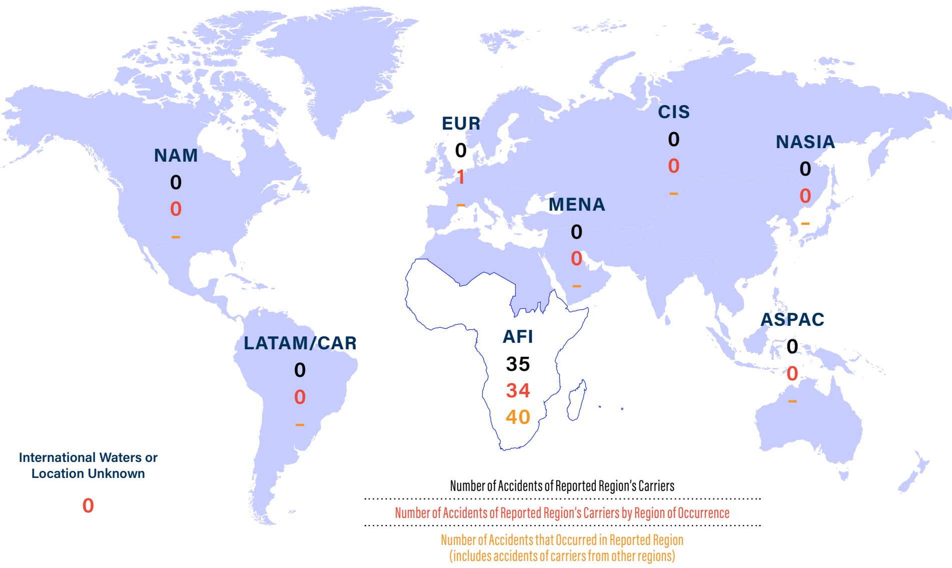
Accident Count % of Total	2019	'15-'19
IATA Member	44%	29%
Full-Loss Equivalents	22%	14%
Fatal	22%	14%
Hull Losses	22%	37%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	89%	11%	0%	44%	56%
2015-2019	66%	34%	0%	40%	60%

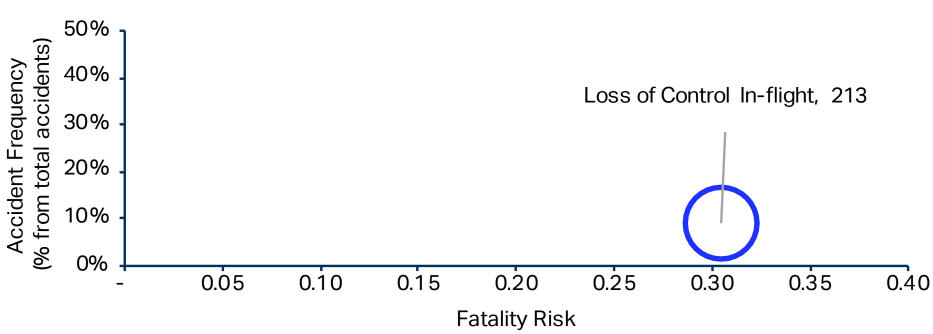
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



Note: 2 accidents could not be assigned an End State but had 11 fatalities

The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Regulatory Oversight:
39%

Threats

Airport Facilities:
35%

Flight Crew Errors

Manual Handling/Flight Controls:
26%

Undesired Aircraft State

Long/floated/bounced/firm/off-center/crabbed landing and Vertical / Lateral / Speed deviation:
22%

Countermeasure

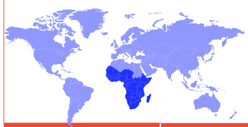
Overall crew performance and In-flight decision-making/contingency management:
17%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Africa Aircraft Accidents – Accident Rate*

2019 Accident rate: 6.03
2015-2019 Accident rate: 5.33



Accident Rate*	2019	'15-'19
IATA Member	5.66	3.32
Fatality Risk**	1.34	0.76
Fatal	1.34	0.76
Hull Losses	1.34	1.98

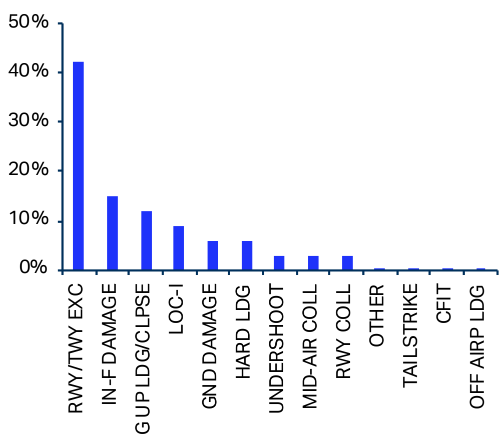
	Jet	Turboprop
2019	5.57	6.47
2015-2019	4.47	6.11

Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

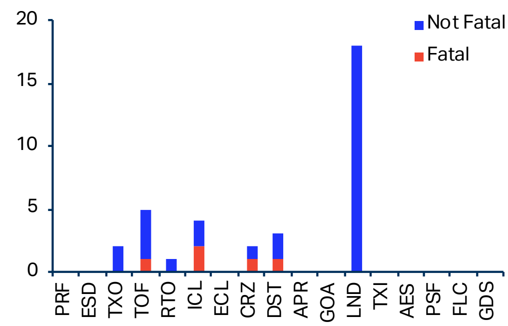
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

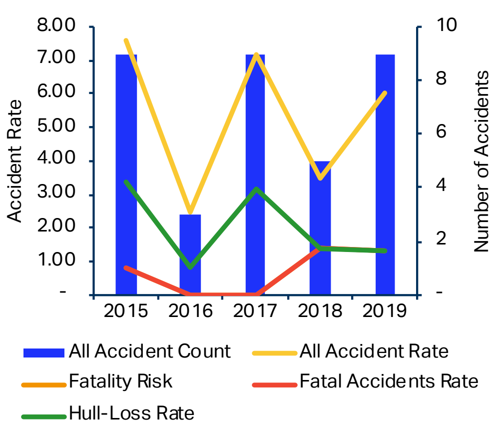
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



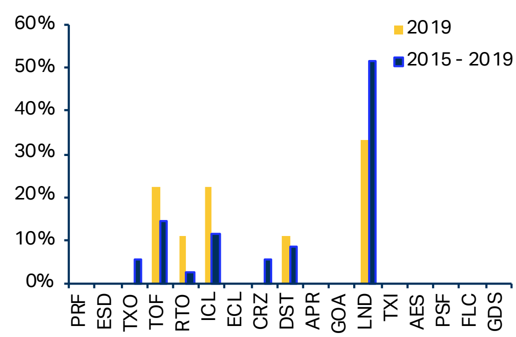
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



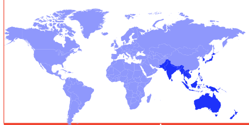
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



Asia/Pacific Aircraft Accidents – Accident Count

2019	Number of accidents: 8	Number of fatalities: 0
2015-2019	Number of accidents: 69	Number of fatalities: 347



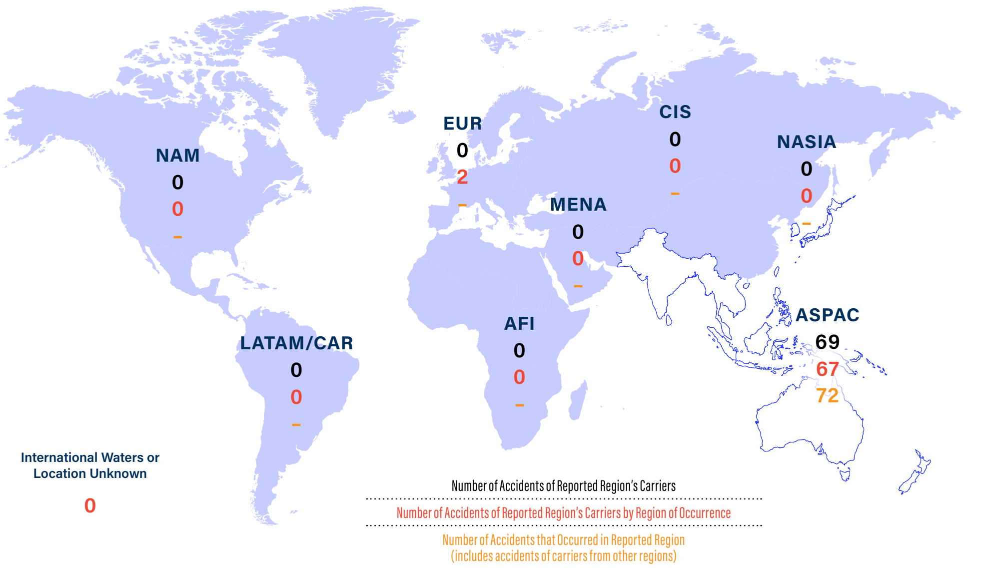
Accident Count % of Total	2019	'15-'19
IATA Member	50%	39%
Full-Loss Equivalents	0%	7%
Fatal	0%	10%
Hull Losses	13%	20%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	100%	0%	0%	50%	50%
2015-2019	88%	12%	0%	65%	35%

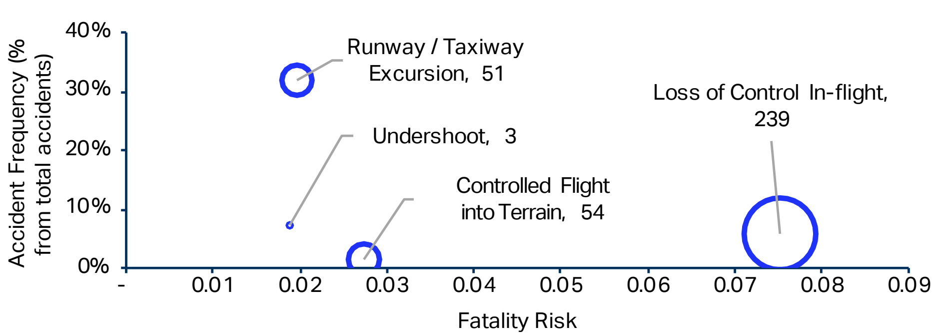
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Regulatory Oversight:
55%

Threats

Meteorology:
35%

Flight Crew Errors

Manual Handling/Flight Controls:
49%

Undesired Aircraft State

Vertical / Lateral / Speed Deviation:
32%

Countermeasure

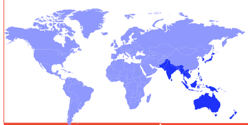
Overall Crew Performance:
37%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Asia/Pacific Aircraft Accidents – Accident Rate*

2019 Accident rate: 0.99
2015-2019 Accident rate: 1.89



Accident Rate*	2019	'15-'19
IATA Member	1.19	1.86
Fatality Risk**	–	0.14
Fatal	–	0.19
Hull Losses	0.12	0.38

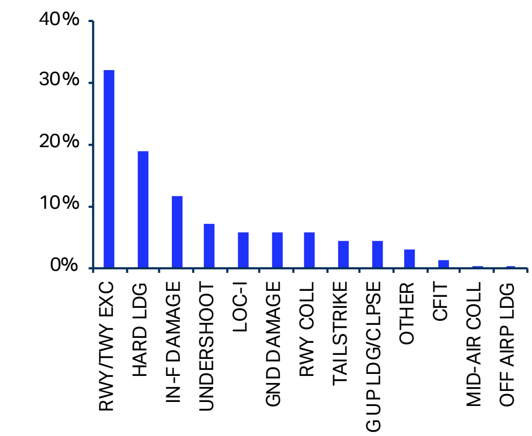
	Jet	Turboprop
2019	0.64	2.19
2015-2019	1.60	2.84

Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

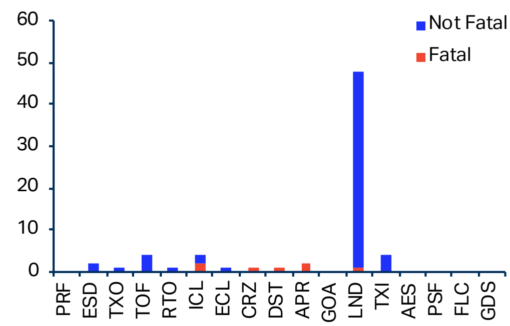
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

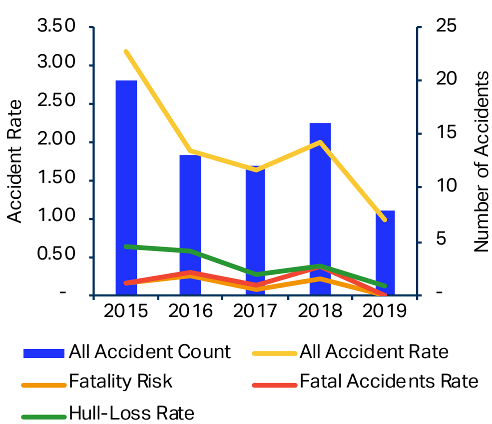
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



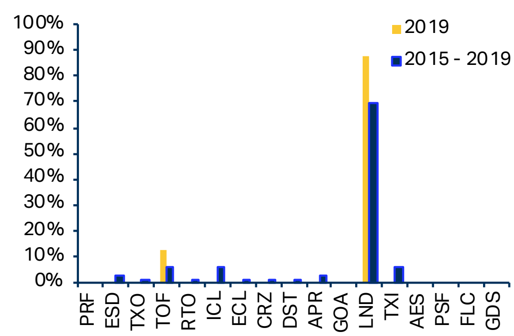
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



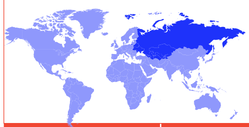
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



Commonwealth of Independent States (CIS) Aircraft Accidents – Accident Count

2019	Number of accidents: 6	Number of fatalities: 60
2015-2019	Number of accidents: 29	Number of fatalities: 168



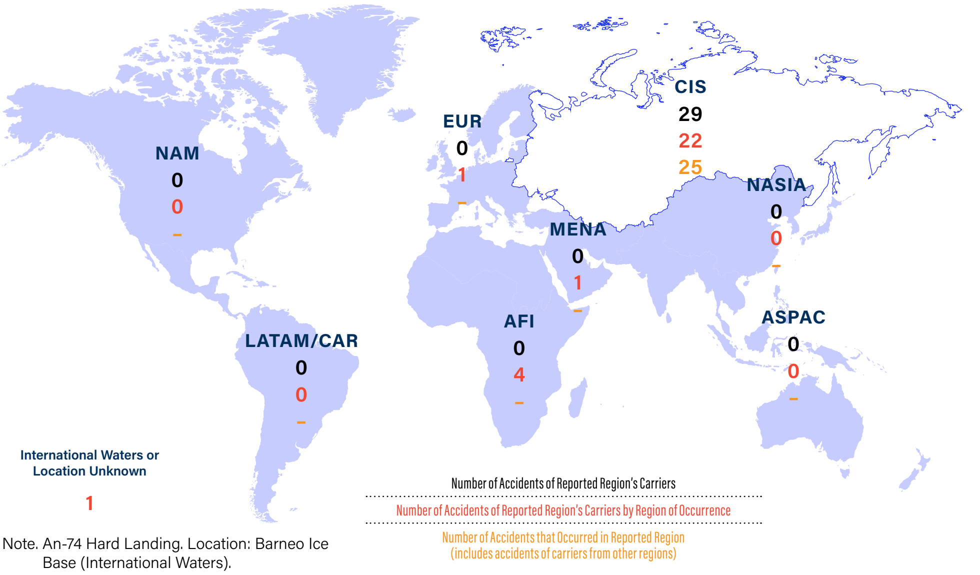
Accident Count % of Total	2019	'15-'19
IATA Member	50%	24%
Full-Loss Equivalents	22%	18%
Fatal	67%	31%
Hull Losses	83%	55%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	83%	17%	0%	67%	33%
2015-2019	72%	24%	3%	69%	31%

Note: the sum may not add to 100% due to rounding

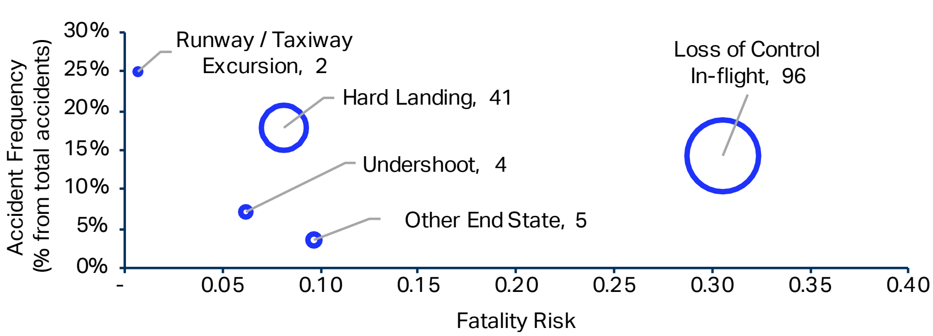
Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Note. An-74 Hard Landing. Location: Barneo Ice Base (International Waters).

Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Safety Management:
37%

Threats

Meteorology:
52%

Flight Crew Errors

Manual Handling/ Flight Controls and SOP Adherence / SOP Cross-verification:
48%

Undesired Aircraft State

Long/floated/bounced/ firm/off-center/crabbed landing:
33%

Countermeasure

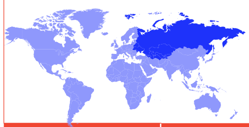
Overall Crew Performance:
30%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Commonwealth of Independent States (CIS) Aircraft Accidents – Accident Rate*

2019 Accident rate: 4.04
2015-2019 Accident rate: 4.48



Accident Rate*	2019	'15-'19
IATA Member	3.30	1.81
Fatality Risk**	0.88	0.81
Fatal	2.69	1.39
Hull Losses	3.36	2.47

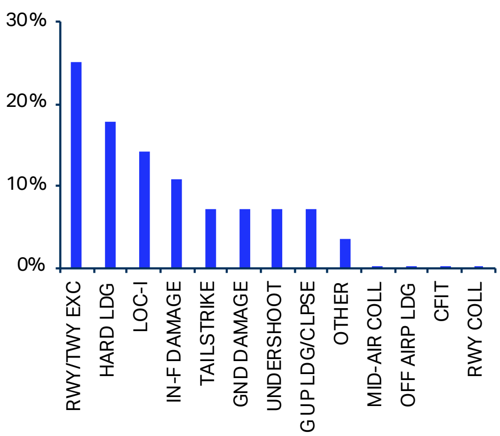
	Jet	Turboprop
2019	2.94	15.79
2015-2019	3.40	15.41

Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

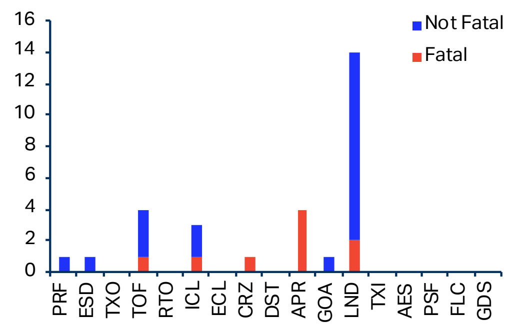
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

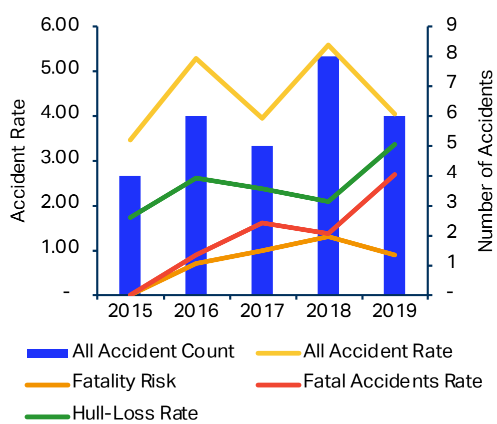
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



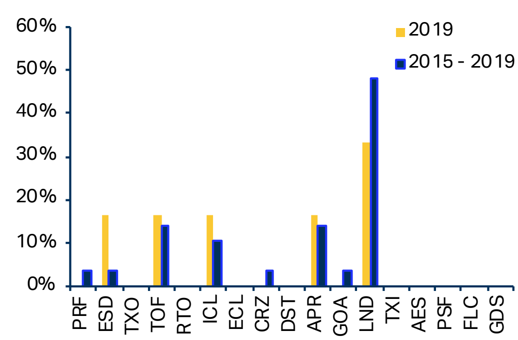
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



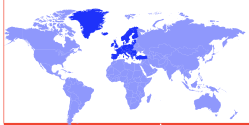
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



Europe Aircraft Accidents – Accident Count

2019	Number of accidents: 5	Number of fatalities: 0
2015-2019	Number of accidents: 42	Number of fatalities: 6



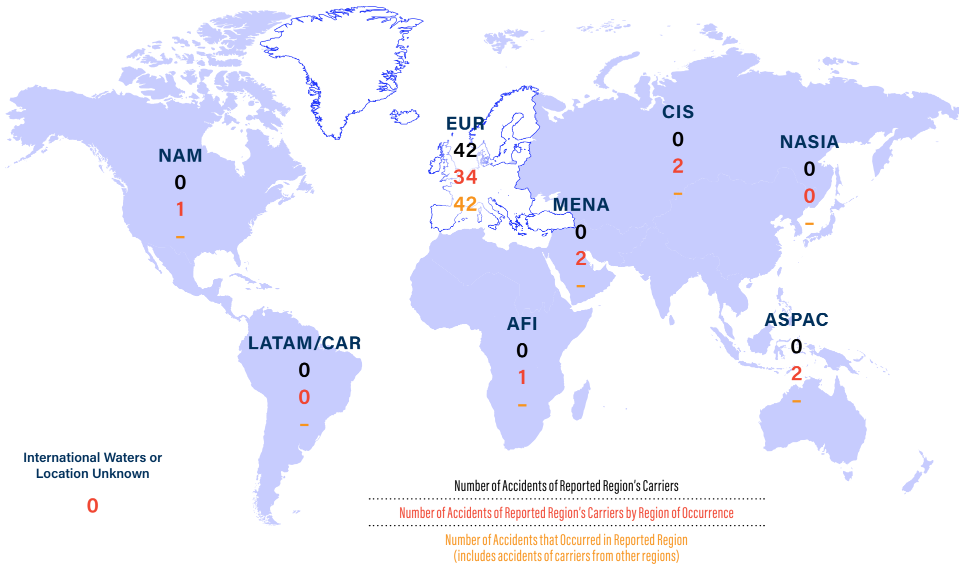
Accident Count % of Total	2019	'15-'19
IATA Member	60%	57%
Full-Loss Equivalents	0%	5%
Fatal	0%	5%
Hull Losses	0%	10%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	100%	0%	0%	80%	20%
2015-2019	88%	12%	0%	74%	26%

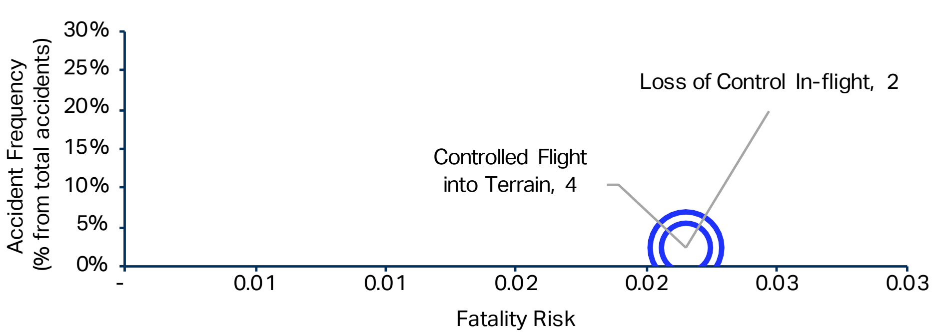
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Flight Operations:
21%

Threats

Meteorology:
36%

Flight Crew Errors

Manual Handling/Flight Controls:
44%

Undesired Aircraft State

Vertical/Lateral/Speed Deviation:
28%

Countermeasure

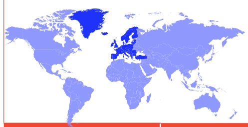
Overall Crew Performance:
31%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Europe Aircraft Accidents – Accident Rate*

2019	Accident rate: 0.50
2015-2019	Accident rate: 0.90



Accident Rate*	2019	'15-'19
IATA Member	0.54	0.96
Fatality Risk**	-	0.04
Fatal	-	0.04
Hull Losses	-	0.09

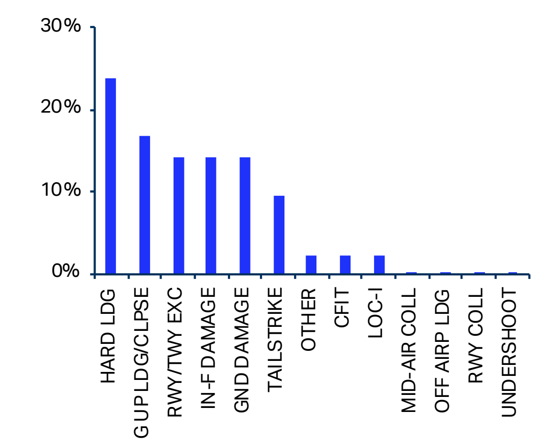
	Jet	Turboprop
2019	0.47	0.69
2015-2019	0.78	1.58

Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

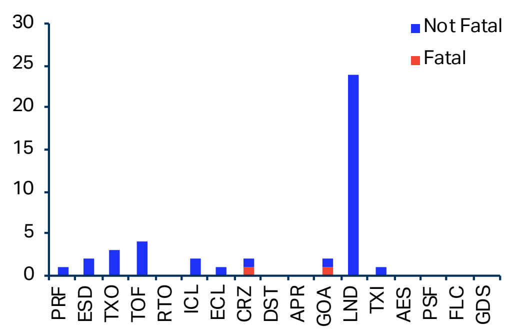
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

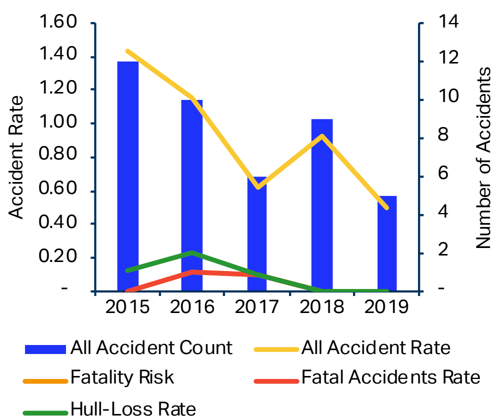
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



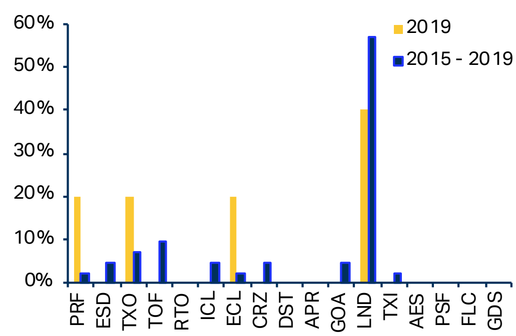
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



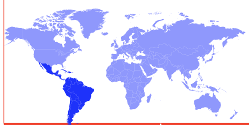
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



Latin America & the Caribbean Aircraft Accidents – Accident Count

2019	Number of accidents: 6	Number of fatalities: 0
2015-2019	Number of accidents: 32	Number of fatalities: 189



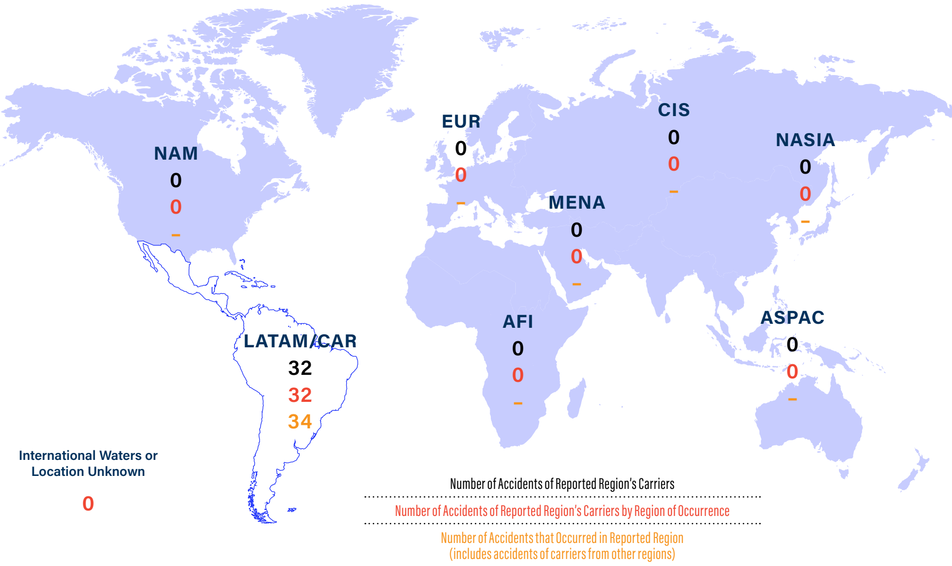
Accident Count % of Total	2019	'15-'19
IATA Member	0%	16%
Full-Loss Equivalents	0%	9%
Fatal	0%	13%
Hull Losses	17%	22%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	100%	0%	0%	17%	83%
2015-2019	84%	16%	0%	59%	41%

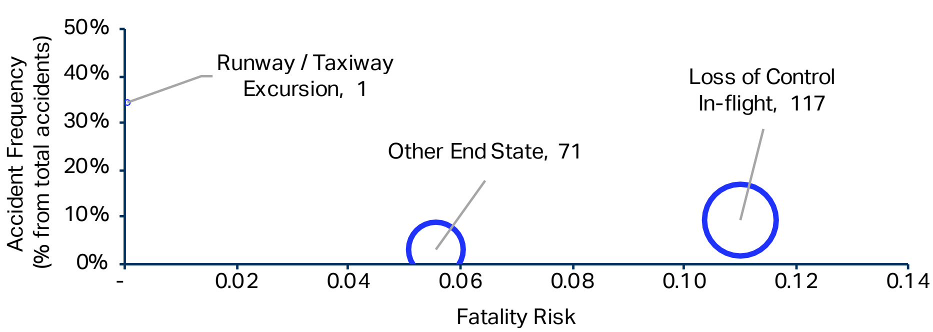
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Regulatory Oversight and Safety management:

38%

Threats

Aircraft Malfunction:

41%

Flight Crew Errors

SOP Adherence / SOP Cross-verification:

24%

Undesired Aircraft State

Unnecessary Weather Penetration and Operation outside aircraft limitations:

14%

Countermeasure

In-flight decision-making/ contingency management and Monitor / Cross-check:

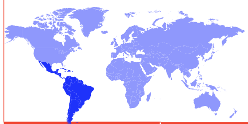
21%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Latin America & the Caribbean Aircraft Accidents – Accident Rate*

2019 Accident rate: 1.73
2015-2019 Accident rate: 1.93



Accident Rate*	2019	'15-'19
IATA Member	-	0.45
Fatality Risk**	-	0.17
Fatal	-	0.24
Hull Losses	0.29	0.42

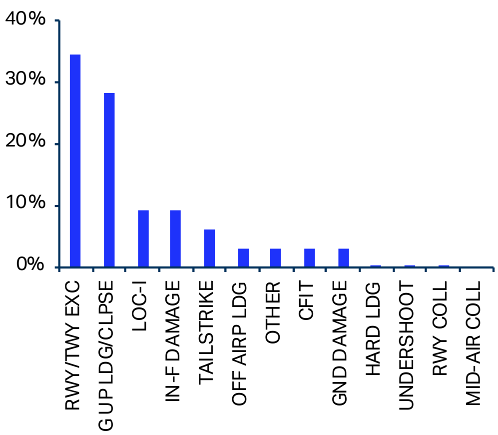
	Jet	Turboprop
2019	0.37	6.60
2015-2019	1.49	3.38

Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

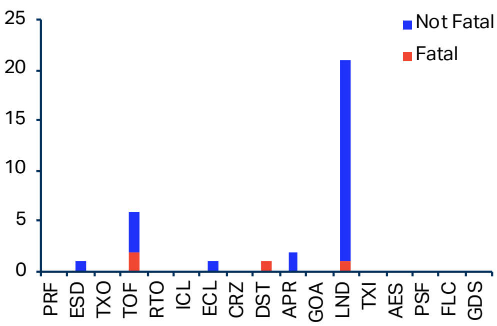
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

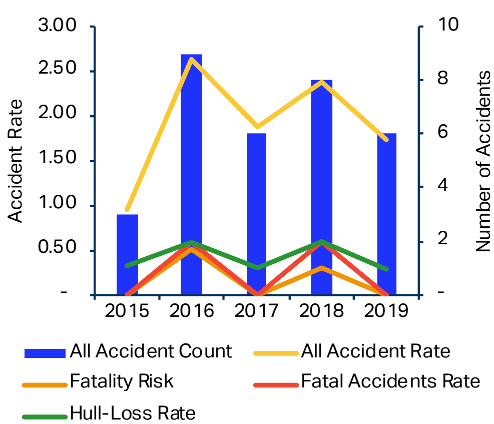
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



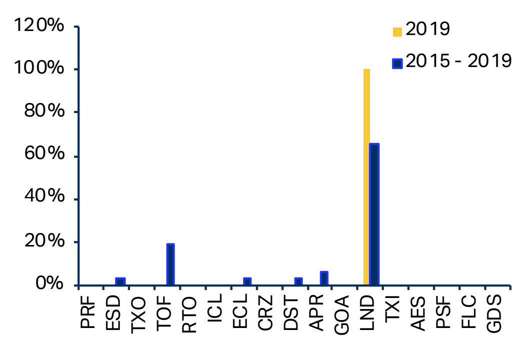
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



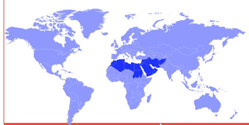
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



Middle East & North Africa Aircraft Accidents – Accident Count

2019	Number of accidents:	1	Number of fatalities:	0	
2015-2019	Number of accidents:	17	Number of fatalities:	128	



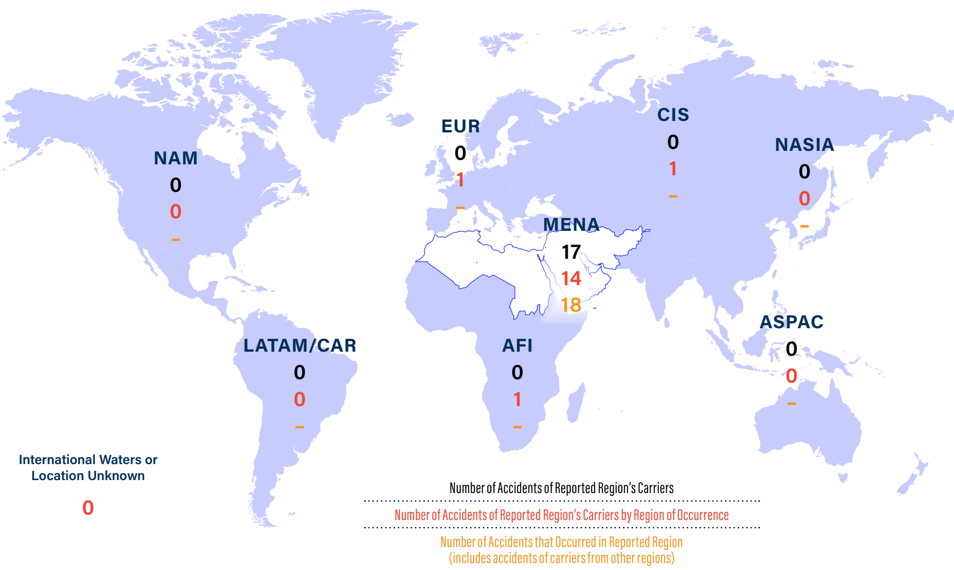
Accident Count % of Total	2019	'15-'19
IATA Member	100%	71%
Full-Loss Equivalents	0%	12%
Fatal	0%	12%
Hull Losses	0%	24%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	100%	0%	0%	100%	0%
2015-2019	94%	0%	6%	88%	12%

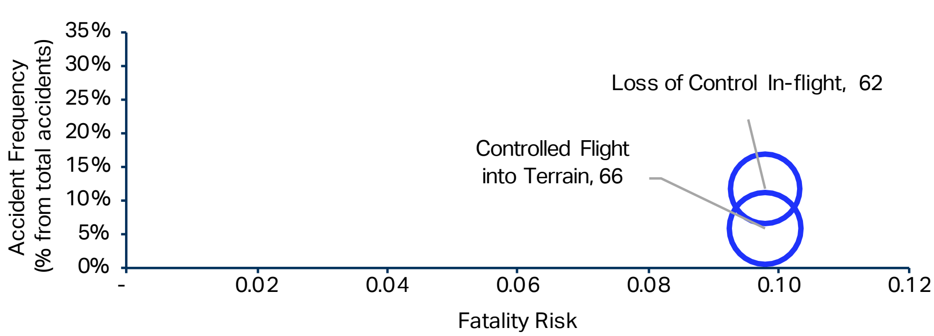
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Safety Management:
44%

Threats

Aircraft Malfunction:
44%

Flight Crew Errors

Manual Handling/Flight Controls:
38%

Undesired Aircraft State

Long/floated/bounced/firm/off-center/crabbed landing, Operation outside aircraft limitations, and engine:
19%

Countermeasure

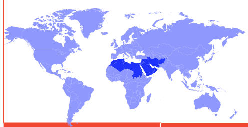
Overall Crew Performance and Monitor / Cross-check:
25%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Middle East & North Africa Aircraft Accidents – Accident Rate*

2019 Accident rate: 0.44
2015-2019 Accident rate: 1.66



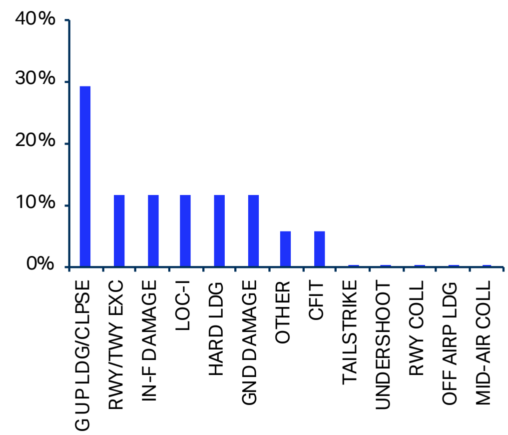
Accident Rate*	2019	'15-'19
IATA Member	0.56	1.47
Fatality Risk**	–	0.20
Fatal	–	0.20
Hull Losses	–	0.39

	Jet	Turboprop	
2019	0.47	–	Accident rates for Passenger, Cargo and Ferry are not available.
2015-2019	1.56	3.33	

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

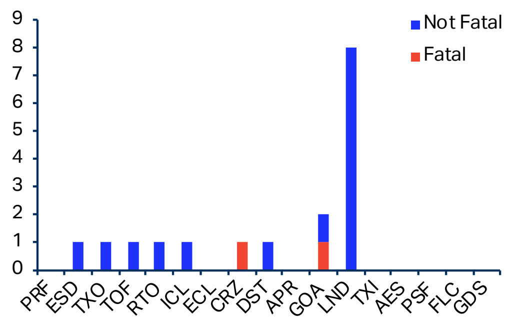
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

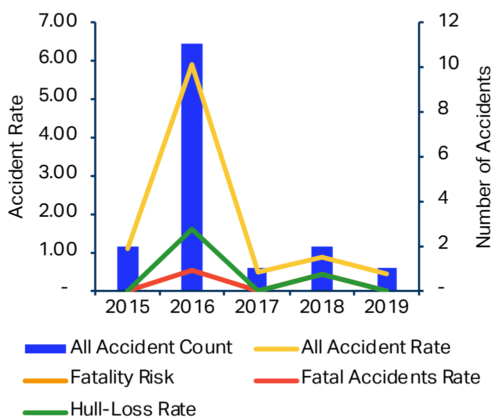
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



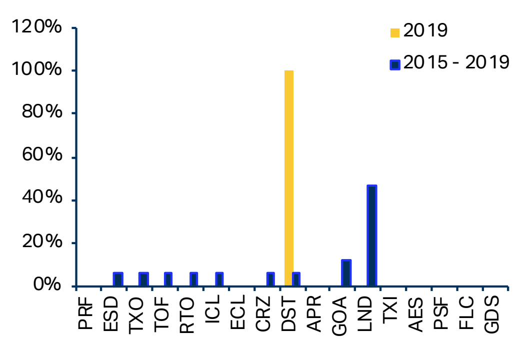
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



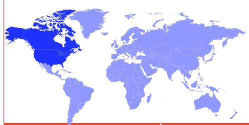
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



North America Aircraft Accidents – Accident Count

2019	Number of accidents: 17	Number of fatalities: 4
2015-2019	Number of accidents: 60	Number of fatalities: 11



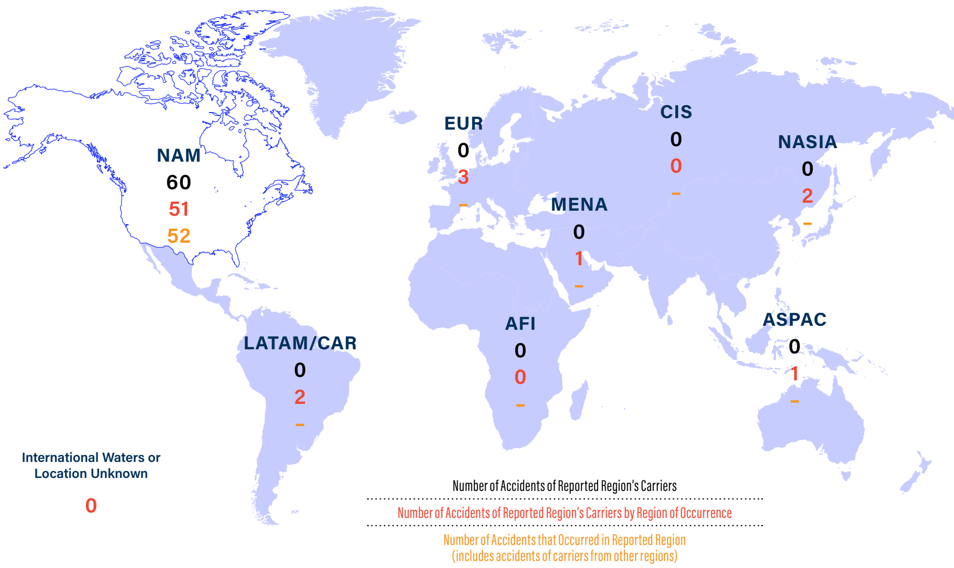
Accident Count % of Total	2019	'15-'19
IATA Member	35%	40%
Full-Loss Equivalents	6%	7%
Fatal	12%	12%
Hull Losses	6%	20%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	82%	18%	0%	71%	29%
2015-2019	78%	22%	0%	73%	27%

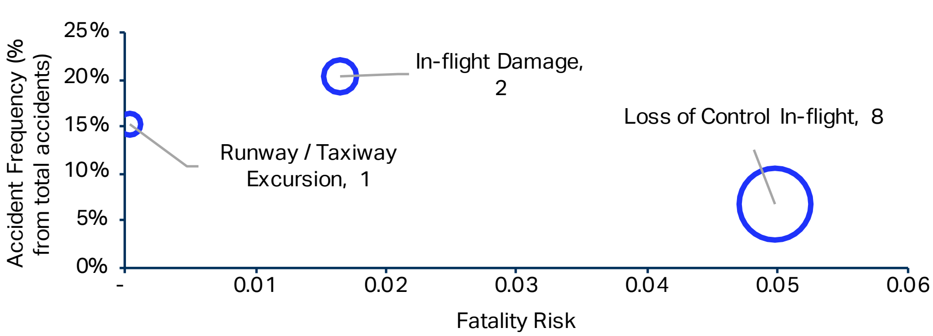
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Safety Management:
20%

Threats

Meteorology:
41%

Flight Crew Errors

Manual Handling/Flight Controls:
30%

Undesired Aircraft State

Vertical/Lateral/Speed Deviation:
20%

Countermeasure

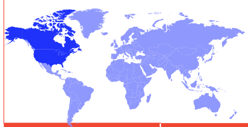
Overall Crew Performance and Monitor / Cross-Check:
15%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

North America Aircraft Accidents – Accident Rate*

2019 Accident rate: 1.27
2015-2019 Accident rate: 0.98



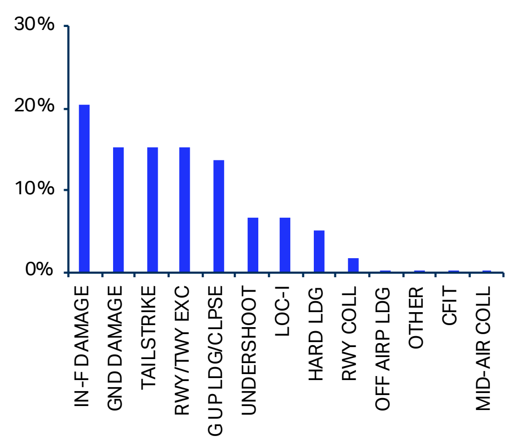
Accident Rate*	2019	'15-'19
IATA Member	1.11	1.00
Fatality Risk**	0.08	0.07
Fatal	0.15	0.11
Hull Losses	0.07	0.20

	Jet	Turboprop	
2019	1.07	2.41	Accident rates for Passenger, Cargo and Ferry are not available.
2015-2019	0.87	1.56	

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

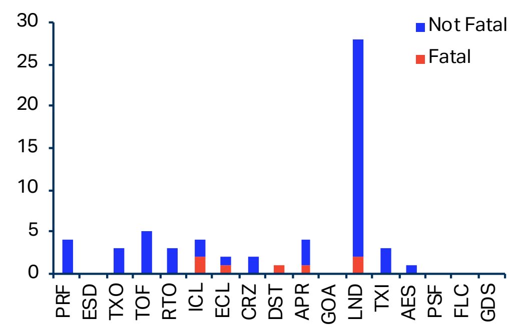
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

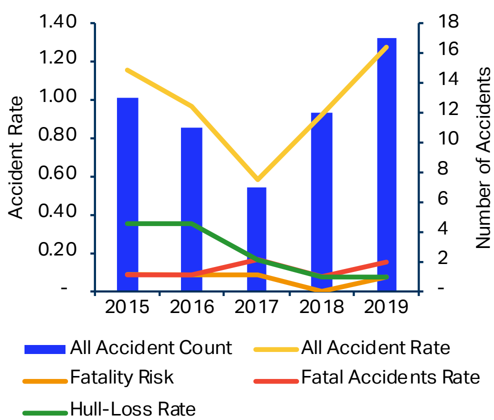
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



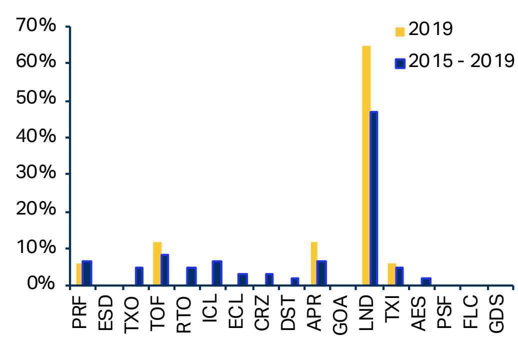
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



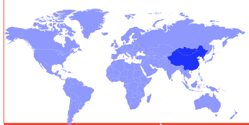
Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



North Asia Aircraft Accidents – Accident Count

2019	Number of accidents:	1	Number of fatalities:	0
2015-2019	Number of accidents:	8	Number of fatalities:	43



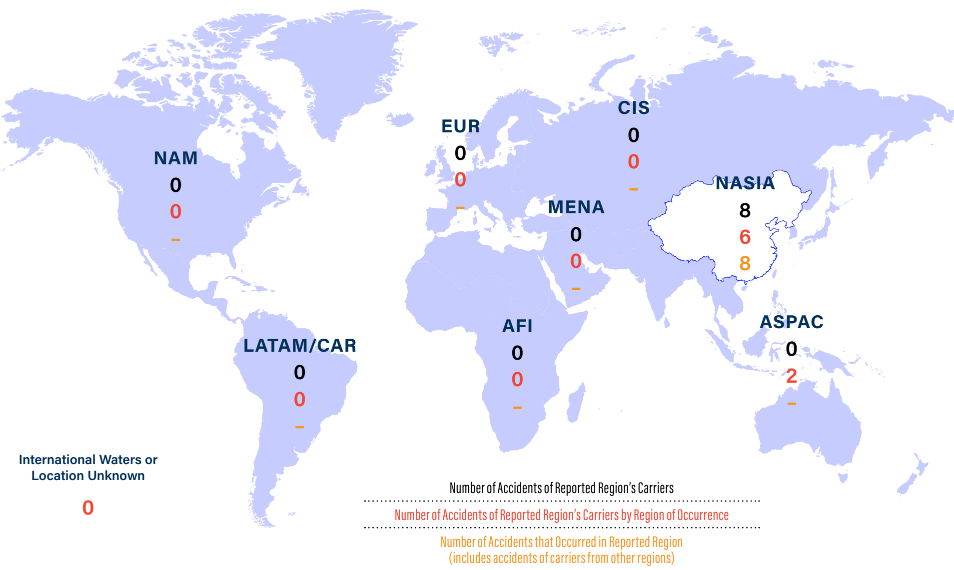
Accident Count % of Total	2019	'15-'19
IATA Member	100%	75%
Full-Loss Equivalents	0%	9%
Fatal	0%	13%
Hull Losses	100%	38%

	Passenger	Cargo	Ferry	Jet	Turboprop
2019	100%	0%	0%	100%	0%
2015-2019	88%	13%	0%	63%	38%

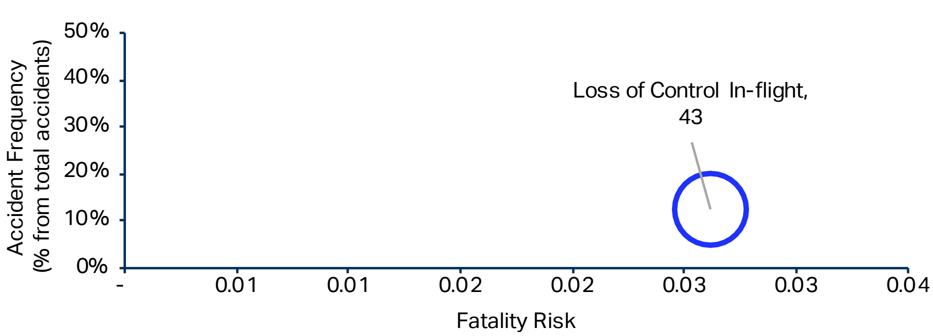
Note: the sum may not add to 100% due to rounding

Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Accident Category Frequency and Fatality Risk (2015-2019)



The graph shows the relationship between the accident category frequency and the fatality risk, measured as the number of full-loss equivalents per 1 million flights. The size of the bubble is an indication of the number of fatalities for each category (value displayed). The graph does not display accidents without fatalities.

Top Primary Contributing factors

Latent Conditions

Flight Operations Training Systems:

57%

Threats

Meteorology Wind/ Wind shear/Gusty wind:

71%

Flight Crew Errors

Manual Handling/Flight Controls:

86%

Undesired Aircraft State

Vertical / Lateral / Speed Deviation:

71%

Countermeasure

Overall crew performance, and Monitor / Cross-check:

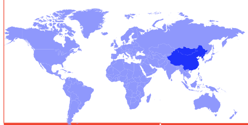
57%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

North Asia Aircraft Accidents – Accident Rate*

2019 Accident rate: 0.15
2015-2019 Accident rate: 0.28



Accident Rate*	2019	'15-'19
IATA Member	0.19	0.26
Fatality Risk**	–	0.03
Fatal	–	0.04
Hull Losses	0.15	0.11

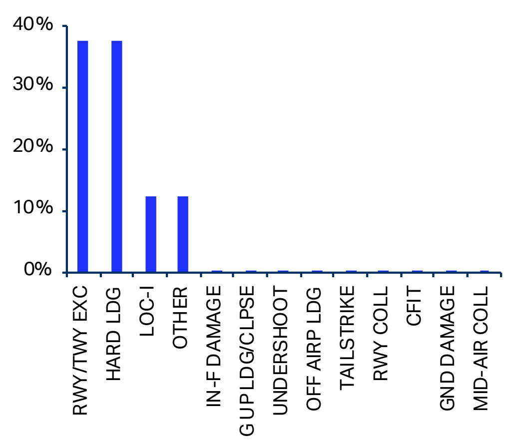
	Jet	Turboprop
2019	0.15	–
2015-2019	0.18	5.65

Accident rates for Passenger, Cargo and Ferry are not available.

*Number of accidents per 1 million flights **Number of full-loss equivalents per 1 million flights

Accident Category Distribution (2015-2019)

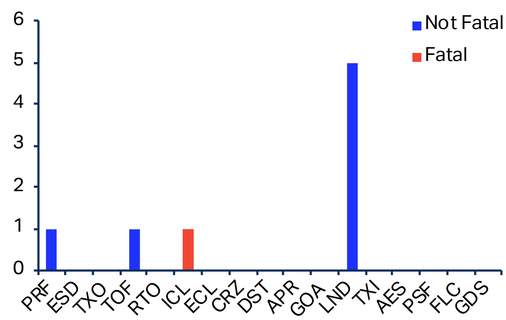
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

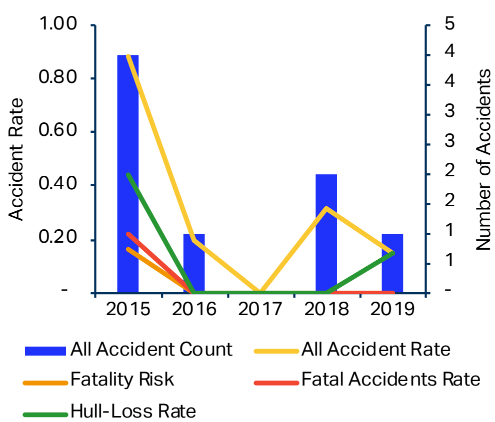
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



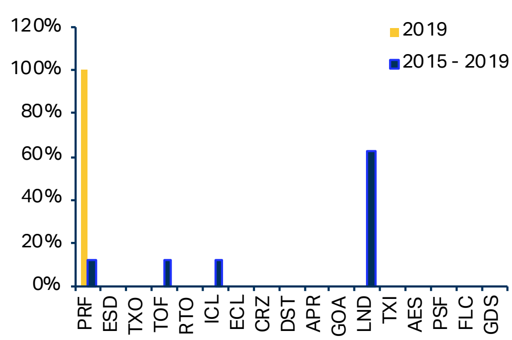
Regional Accident Rate (2015-2019)

Accidents per Million Sectors



Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



6

Analysis of Cargo Aircraft Accidents

2019 CARGO OPERATOR OVERVIEW

CARGO VS. PASSENGER OPERATIONS FOR JET AIRCRAFT

	Fleet Size	HL	HL / 1000 ACTF	SD	SD / 1000 ACTF	Total Acc	Acc / 1000 ACTF
Cargo	2,232	1	0.45	2	0.90	3	1.34
Passenger	25,756	5	0.19	23	0.89	28	1.09
Total	27,988	6	0.21	25	0.89	31	1.11

HL = Hull Loss SD = Substantial Damage

Note: Fleet Size includes both in-service and stored aircraft operated by commercial airlines.
Cargo aircraft are defined as dedicated cargo, mixed passenger/cargo (combi) or quick-change configurations.

CARGO VS. PASSENGER OPERATIONS FOR TURBOPROP AIRCRAFT

	Fleet Size	HL	HL / 1000 ACTF	SD	SD / 1000 ACTF	Total Acc	Acc / 1000 ACTF
Cargo	1,209	1	0.83	1	0.83	2	1.65
Passenger	4,102	4	0.98	16	3.90	20	4.88
Total	5,311	5	0.94	17	3.20	22	4.14

HL = Hull Loss SD = Substantial Damage

Note: Fleet Size includes both in-service and stored aircraft operated by commercial airlines.
Cargo aircraft are defined as dedicated cargo, mixed passenger/cargo (combi) or quick-change configurations.

Cargo Aircraft Accidents – Accident Count

2019	Number of accidents:	5	Number of fatalities:	8
2015-2019	Number of accidents:	51	Number of fatalities:	88

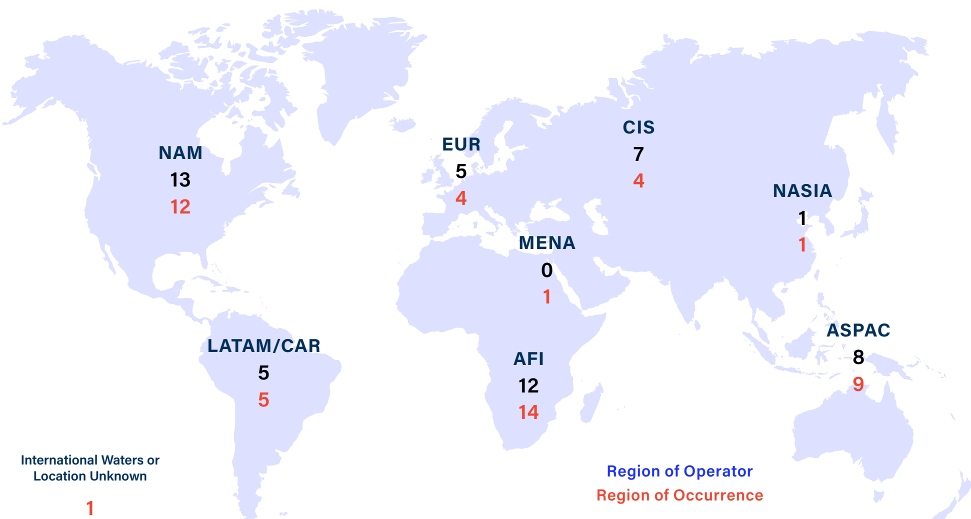
Accident Count % of Total	2019	'15-'19
IATA Member	20%	8%
Full-Loss Equivalents	33%	26%
Fatal	40%	29%
Hull Losses	40%	53%

	Jet	Turboprop
2019	60%	40%
2015-2019	45%	55%

Note: the sum may not add to 100% due to rounding

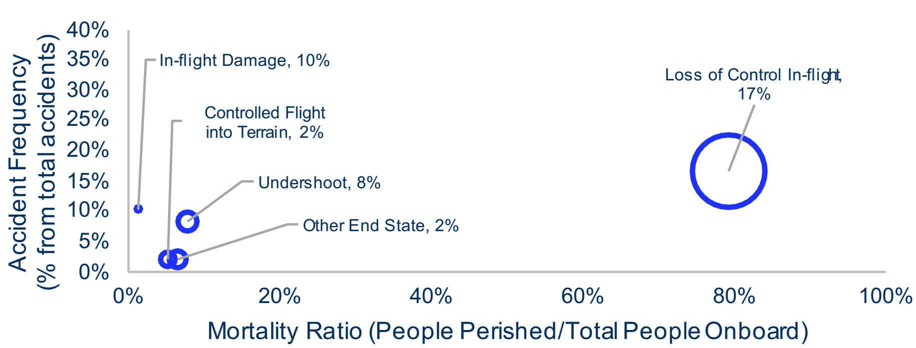
Number of Accidents per Region (2015-2019)

The accident rate based on region of occurrence is not available, therefore the map only displays counts



Note: An74 Hard Landing. Location: Barneo Ice Base (International Waters)

Accident Category Frequency and Fatality Risk (2015-2019)



Note: Since the sector count broken down by cargo flights is not available, rates could not be calculated. The 'fatality risk' rate was therefore substituted by a 'fatality ratio' value, which is the total number of fatalities divided by the total number of people carried. Although this removes the effect of the percentage of people who perished in each fatal crash, it can still be used as a reference to determine which accident categories contributed the most to the amount of fatalities on cargo flights. Accident categories with no fatalities are not displayed.

Top Primary Contributing factors

Latent Conditions

Regulatory Oversight and Safety management:

35%

Threats

Meteorology:

45%

Flight Crew Errors

Manual Handling/Flight Controls:

40%

Undesired Aircraft State

Vertical / Lateral / Speed Deviation:

28%

Countermeasure

Overall Crew Performance and Monitor / Cross-check:

28%

For more info regarding primary contributing factors, see Section 8.

➤ See detailed view

Cargo Aircraft Accidents – Accident Rate*

Accident rate*: –

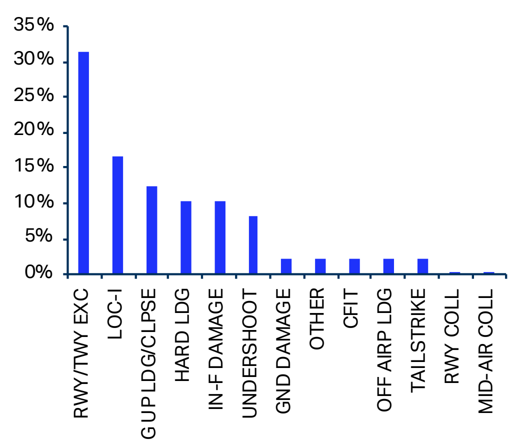
Accident Rate*	2019
IATA Member	-
Fatality Risk**	-
Fatal	-
Hull Losses	-

Cargo	
-	Cargo accident rates are not available

Note: the number of sectors for cargo flights is not available, therefore the rate calculation is not being shown

Accident Category Distribution (2015-2019)

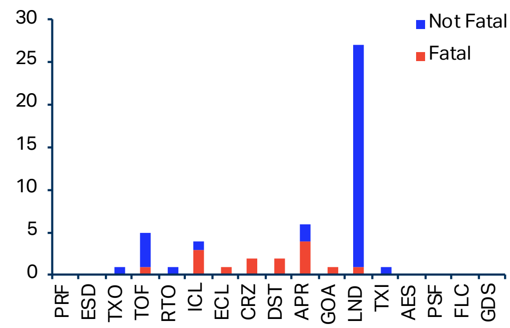
Distribution of accidents as percentage of total



Note: End State names have been abbreviated.
Refer to list of Acronyms/Abbreviations section for full names.

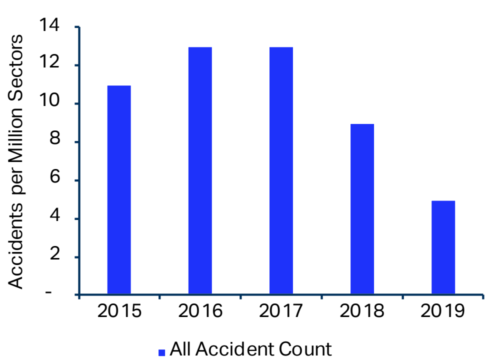
Accidents per Phase of Flight (2015-2019)

Total Number of Accidents (Fatal vs. Nonfatal)



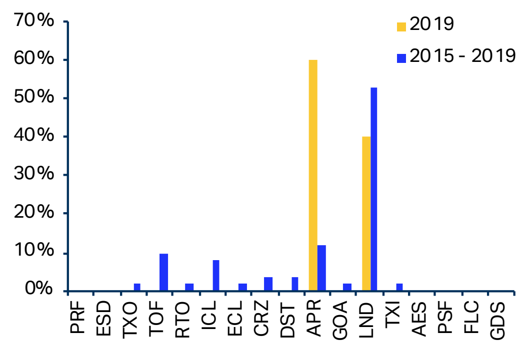
Five-Year Trend (2015-2019)

See Annex 1 for the definitions of metrics used



Accidents per Phase of Flight (2015-2019)

Distribution of accidents as percentage of total



7

Cabin Safety

CABIN SAFETY

Cabin Safety is at the heart of every activity in the cabin. While heavily regulated, there is usually a degree of flexibility for airlines to make their own decisions on products and services offered to passengers, as long as safety is considered and managed effectively.

IATA's role is to keep airlines informed of regulatory changes, give advice on best practices, explore new and emerging issues in the area of cabin safety, and act as a resource for help.

Incorporating a SMS within Cabin Operations is actively encouraged by IATA and we create and maintain standards and guidance for airlines to help them to do so effectively. We have recently published a set of Cabin Safety Risk Assessments in our Cabin Operations Safety Best Practices Guide to help airlines understand the risk assessment process more clearly and provide them with the tools they may need to fully incorporate these principles into their daily operations.

This section of the annual IATA Safety Report is intended to provide the reader with an update of the activities of IATA Cabin Safety during 2019, all of which are aimed at supporting IATA members worldwide and driving improvement to cabin operations and safety.

CABIN SAFETY PROMOTION

Safety promotion is a major component of SMS and the sharing of safety information is an important focus for IATA. The organization of global conferences and regional seminars brings together a broad spectrum of experts and stakeholders to exchange cabin safety information.

The global IATA Cabin Operations Safety Conference has become an established and popular venue for the exchange of ideas and education of Cabin Safety specialists. The format of this event aims to educate and inform delegates with plenary and interactive workshops focusing on the issues identified through IATA's activities as needing focus and attention.

IATA CABIN OPERATIONS SAFETY TECHNICAL GROUP

The IATA Cabin Operations Safety Technical Group (COSTG) is established to maintain a close working link with the operational environment.

The members of the COSTG are industry experts in the cabin safety environment and include safety investigators, policymakers, cabin crew trainers and safety auditors. A global representation of member airlines is maintained, and membership is reviewed every two years.

The COSTG mandate includes reviewing and updating the IOSA standards relating to cabin operations, updating all IATA Cabin Safety guidance materials, keeping IATA Cabin Safety informed of emerging risks within cabin operations and identifying key Safety Performance Indicators which can be used to assess the efficacy of current procedures and mitigations.

COSTG Members (2019-2020)

Lisa Mounce AMERICAN AIRLINES	Anabel Brough EMIRATES	Lerato Luti SOUTH AFRICAN AIRWAYS
Artem Fillipov AIR ASTANA	Jonathan Jasper (Secretary) IATA	Martin Ruedisueli SWISS INTERNATIONAL AIR LINES
Christiane Raspa AIR CANADA	Berry Ochieng' KENYA AIRWAYS	Carlos Mouzaco Dias TAP PORTUGAL
Anne Frederique Houlbreque AIR FRANCE	Julia Arnds LUFTHANSA	Mary Gooding VIRGIN ATLANTIC AIRWAYS
Gennaro Anastasio ALITALIA	Rosnina Abdullah MALAYSIA AIRLINES BERHAD	Sophie O'Ferrall VIRGIN AUSTRALIA
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IATA CABIN OPERATIONS SAFETY BEST PRACTICES GUIDE (6th EDITION)

The IATA Cabin Operations Safety Best Practices Guide is intended to give airlines the tools they need to create and update safety procedures and policies, using a global range of references and expert opinions. It is provided free of charge to IATA member airlines and available for purchase on the IATA Store.

This guide is updated annually by a global team of cabin safety professionals. It includes standards and recommended practices from IOSA, ICAO and other regulators, combined with the extensive operational experience of our member airlines. It suggests and gives guidance in the appropriate risk assessments to demonstrate the incorporation of SMS within cabin operations.

Before embarking on an update to the guide, we look at areas for improvement across the IOSA auditing findings and observations and seek feedback from our stakeholders and customers at the IATA Cabin Operations Safety Conference. We can then tailor any amendment to provide further up-to-date guidance in any areas which may need it.

As with all safety-related reference documents, it is important to keep up-to-date with any changes and new requirements. This latest edition includes updated information in the following areas:

- Risk assessments, including completed examples of cabin-related safety risk assessments
- Cabin Line Operations Safety Audit (LOSA)
- Safety Performance Measurement and guidance on cabin-related safety performance targets
- Administration of a Cabin Safety Action Group

HEALTH AND SAFETY GUIDELINES – PASSENGERS AND CREW

In the airline industry, health-related issues concerning passengers or crew are crucial in most activities (e.g., aircraft operations, passenger transport, cargo). They cover matters as diverse as duty time limitation, transmission of communicable diseases and disinfection.

IATA's Medical Advisory Group creates guidelines regarding the health and safety of passengers and crew and regularly reviews the recommendations on the carriage of emergency medical equipment, medications and first aid kits.

These guidelines and many others are available at: www.iata.org/health.

IOSA AND CABIN OPERATIONS SAFETY

The IOSA Standards Manual (ISM) includes Section 5 – Cabin Operations (CAB), which contains key elements of cabin safety, such as the IATA Standards and Recommended Practices (ISARPs) for:

- Management and control
- Training and qualification
- Line operations
- Cabin systems and equipment

These standards are reviewed annually by the COSTG and updated where necessary to enhance the understanding and application of safety standards globally. For more information on IOSA and to download the latest version of the ISM, go to: www.iata.org/iosa.

ACCIDENTS – CABIN END STATES

This section of the Safety Report highlights the categories of cabin safety end states that resulted from an accident. Only those that were classified as an accident in accordance with the IATA definition are included in this analysis.

The following definitions apply to the end states in this section:

- **Normal Disembarkation:** Passengers and/or crew exit the aircraft via boarding doors during normal operations.
- **Rapid Deplaning:** Passengers and/or crew rapidly exit the aircraft via boarding doors and jet bridges or stairs, as a precautionary measure.
- **Abnormal Disembarkation:** Passengers and/or crew exit the aircraft via boarding doors (normally assisted by internal aircraft or exterior stairs) after a non-life-threatening and non-catastrophic aircraft incident or accident and when away from the boarding gates or aircraft stands (e.g., on a runway or taxiway).
- **Evacuation (land):** Passengers and/or crew evacuate the aircraft via escape slides/slide rafts, doors, emergency exits, or gaps in the fuselage; usually initiated in life-threatening and/or catastrophic events.
- **Evacuation (water):** Passengers and/or crew evacuate the aircraft via escape slides/slide rafts, doors, emergency exits, or gaps in the fuselage into or onto water.
- **Hull Loss/Nil Survivors:** Aircraft impact resulting in a complete hull loss and/or no survivors.

While knowing the method cabin crew use to disembark passengers following an accident will vary, it is of limited value within cabin crew training as it does not explain the impact the emergency had on the cabin crew, or how they may have adapted their procedures to the situation.

During 2019, we added the following additional classifications, identifying the time the cabin crew had available to prepare for the evacuation and the type of preparation undertaken:

- **Normal SOP:** Use of this classification means that the cabin was prepared for a normal takeoff or landing and no additional safety procedures or briefings were undertaken.
- **Emergency EP:** The use of this classification means that the cabin crew were fully aware of the impending possibility of evacuation and additional safety procedures and briefings may have been carried out.
- **Preparation Time Nil:** This classification is used when there was no additional preparation time or prior warning before the accident.
- **Preparation Time Short:** This classification is used in accidents where the cabin crew had some warning of the emergency landing and a short amount of time for additional preparations, which may include a higher level of alertness and/or some additional preparations within a timescale of approximately 10 minutes.
- **Preparation Time Long:** This classification is used in accidents where the cabin crew had more than 10 minutes to prepare the cabin, typically using additional procedures and briefings to ensure readiness.

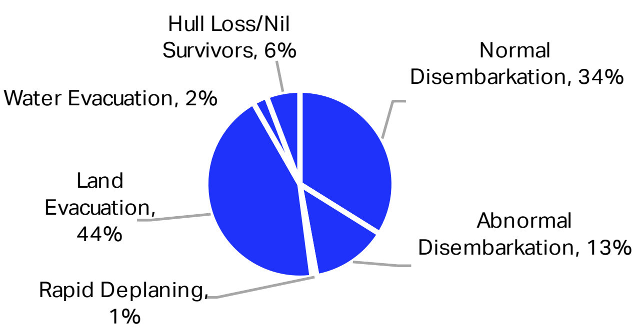
Cabin End States

	2019	2017-2019
Total 'Passenger-only' Accidents	48	134

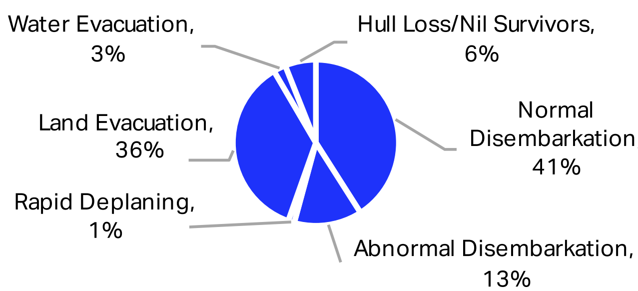
The total number of passenger-only accidents in 2019 was 48, down from 53 in 2018. This small number of accidents make it difficult to identify trends or patterns and draw conclusions; therefore, this figure was added to data from 2017 onward. This combined figure of 134 accidents was used in the following tables. Not all of the accident narratives identified a cabin end state.

	2017-2019					
	Normal Disembarkation	Abnormal Disembarkation	Land Evacuation	Water Evacuation	Hull Loss/ Nil survivors	Total
All	41	16	53	3	7	120
IATA Member	23	6	18	1	2	50
IOSA-Registered	29	9	24	1	3	66
Fatal	0	1	7	2	7	17
Hull Loss	0	0	12	2	7	21
Jet	34	11	30	2	5	82
Turboprop	7	5	23	1	2	38

Cabin End State – Jet and Turboprop Aircraft



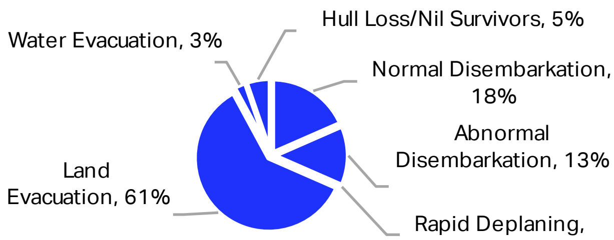
Cabin End State – Jet



Overall, in 47% of accidents, passengers were able to disembark the aircraft in an orderly manner using boarding doors, either normally (34%) or abnormally (13%). Evacuation procedures were carried out in 46% of accidents. Only 1% of the reports were categorized using the Rapid Deplaning definition. This procedure is used as a precautionary measure in case a situation worsens. IATA recommends that airlines have such procedures included in their operations manuals, but it is more likely that this procedure would be used during a safety incident, rather than an accident.

In 54% of jet aircraft accidents, passengers were able to disembark the aircraft in an orderly manner using boarding doors, either normally (41%) or abnormally (13%). Evacuation procedures were carried out during 39% of accidents on jet aircraft.

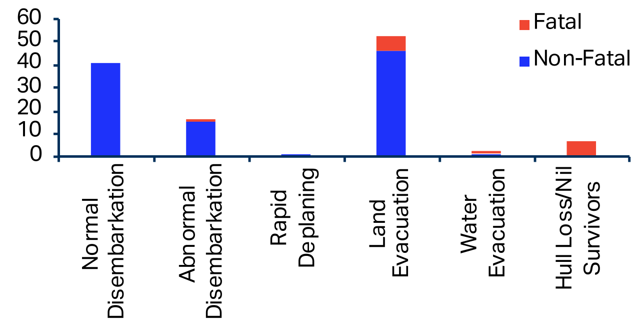
Cabin End State - Turboprop



In turboprop aircraft accidents, normal disembarkation was possible in 18% of cases. Abnormal disembarkation methods were used in 13% of accidents and 61% resulted in an evacuation on land.

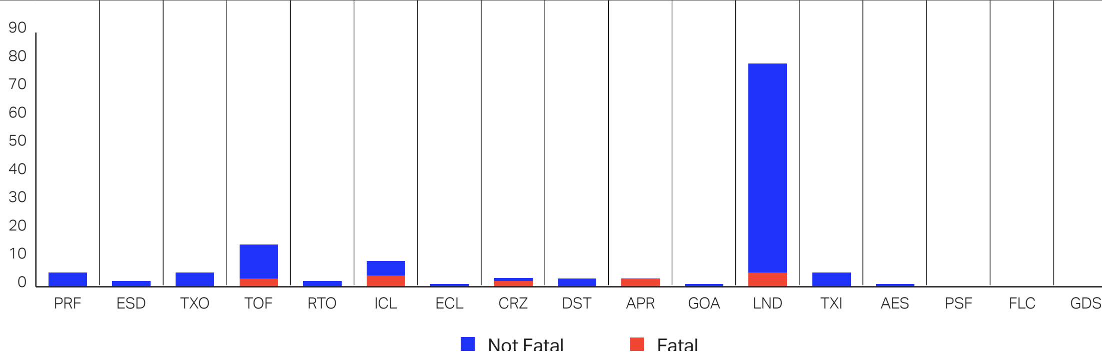
On these smaller aircraft, evacuation to the ground is easier to facilitate as evacuation systems such as integral steps pose lesser risk to the occupants. The distinction between abnormal disembarkation and evacuation is, therefore, less apparent than with larger jet aircraft.

Cabin End States of Accidents Involving/Not Involving Fatalities



Cabin End States per Phase of Flight (2017-2019)

	PRF	ESD	TXO	TOF	RTO	ICL	ECL	CRZ	DST	APR	GOA	LND	TXI	AES	PSF	FLC	GDS
Total Accidents	5	2	5	15	2	9	1	3	3	3	1	79	5	1	0	0	0
Normal Disembarkation	40%	0%	80%	40%	0%	22%	100%	33%	67%	0%	100%	25%	40%	0%	0%	0%	0%
Abnormal Disembarkation	0%	50%	20%	7%	0%	22%	0%	0%	0%	0%	0%	14%	0%	0%	0%	0%	0%
Rapid Deplaning	20%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Land Evacuation	0%	0%	0%	27%	100%	22%	0%	0%	33%	33%	0%	52%	20%	100%	0%	0%	0%
Water Evacuation	0%	0%	0%	0%	0%	0%	0%	0%	0%	67%	0%	1%	0%	0%	0%	0%	0%
Hull Loss/Nil Survivors	0%	0%	0%	20%	0%	22%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%



Total Accidents: 134

Note: please refer to Annex 1 for definition of each phase of flight
Percentages are calculated based on the total number of accidents, not all of which are classified with a cabin end state; therefore, sum may not add to 100%.

The above table shows the distribution of cabin end states per phase of flight. The table's first row shows the total number of accidents for 2017-2019, while the table and chart below give some additional contextual information. Accidents that did not identify a phase of flight are not included in this set.

The most critical stages of flight for cabin crew are taxi, takeoff and landing. During these stages of flight, cabin crew should be secured in their crew seats and carrying out a silent review of safety procedures to increase readiness for evacuation should the need arise (Ref IATA Cabin Operations Safety Best Practices Guide section 12.6).

Accident End States and Cabin End States (2017-2019)

	Total	Normal Disembarkation	Abnormal Disembarkation	Rapid Deplaning	Land Evacuation	Water Evacuation	Hull Loss/ Nil Survivors
Runway / Taxiway Excursion	40	0	4	0	35	1	0
Tail strike	16	16	0	0	0	0	0
In-flight Damage	15	11	3	0	1	0	0
Gear-up Landing / Gear Collapse	13	0	5	0	8	0	0
Loss of Control – In-flight	9	0	0	0	3	0	6
Hard Landing	9	4	2	0	3	0	0
Ground Damage	9	6	1	0	2	0	0
Other End State	3	1	1	1	0	0	0
Undershoot	3	1	0	0	1	1	0
Runway Collision	2	2	0	0	0	0	0
Controlled Flight into Terrain	1	0	0	0	0	0	1
Mid-air Collision	0	0	0	0	0	0	0
Off-airport Landing / Ditching	0	0	0	0	0	0	0

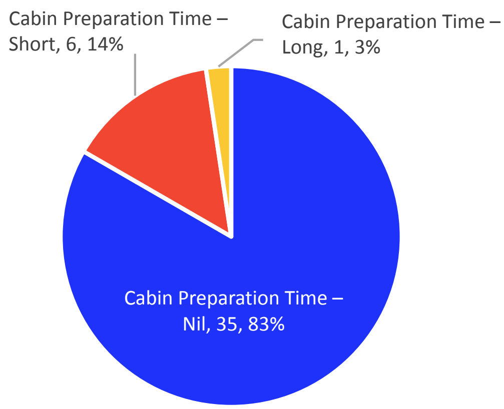
This table shows accident classifications and their associated Cabin End State, in order of frequency, and can provide operators with useful information for cabin crew training exercises and discussion.

It shows, for example, that a runway excursion will most likely result in a land evacuation or abnormal disembarkation and that cabin crew should always be prepared for such a situation upon landing.

The table also shows that gear collapse accidents resulted in eight land evacuation responses and five abnormal disembarkation events.

Water evacuation remains a very low probability with only two events in this dataset, but as the severity is high, procedures and training are focused on giving cabin crew the tools they may need to manage such rare situations.

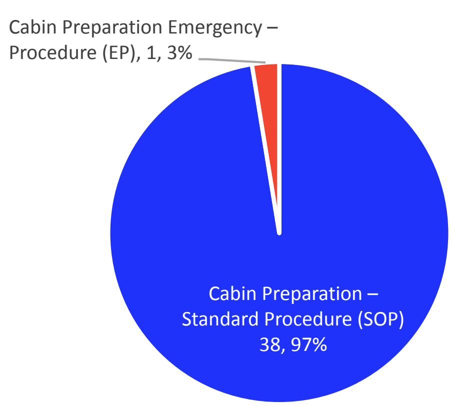
Cabin Preparation Time



The time available to prepare the cabin following indications of an abnormal aircraft state is important for cabin crew to prioritize and coordinate activities. The above graph demonstrates that in 83% of the 42 accidents during 2019 where could be determined, there was no additional time for cabin crew to carry out preparations for emergency evacuation.

In 14% of these accidents, cabin crew were aware of the possibility of an evacuation and had up to 10 minutes to prepare. In one accident (3%), the cabin crew had more than ten minutes to prepare and consider the need for the application of additional safety procedures.

Level of Cabin Preparation



Cabin crew are trained to secure the cabin and check for passenger compliance with safety requirements for every takeoff or landing in case of subsequent evacuation or emergency. In 97% of the 39 accidents where it could be determined, the level of cabin preparation was in accordance with SOPs with no additional Emergency Procedures carried out. This highlights the importance of an effective cabin secure and compliance check before every takeoff and landing.

Safety Briefings

Regulations determine what must be included in the passenger safety briefing information, but it is the airline that determines the method, content and style of delivery. There is often debate about the use of humor within the presentation of safety messages and some suggest that this can undermine the importance of the briefing.

While remaining sensitive to custom and culture, studies have shown the use of humor can, in some cases, have a positive effect on memory retention. The challenge for airlines is to strike the right balance in delivering the safety information correctly, quickly and in a manner that can be easily understood by the majority of passengers carried.

Delivery of the message in a comprehendible manner is the airline's responsibility, but it is also each passenger's responsibility to be attentive to the briefing and recognize what actions they may be required to take during an emergency. Emergency equipment such as life vests and seatbelts can vary between aircraft or even between cabins in the same aircraft, and brace positions may vary according to the seat orientation and restraint devices installed. It is, therefore, important for passengers to take note of these differences during safety briefings, as evidence shows that, in most cases, there is no additional time for cabin crew to provide the information again during an emergency.

Passenger behavior during an emergency evacuation varies greatly and is dependent on many factors. While evacuation demonstration tests require that evacuation of a fully loaded aircraft takes no more than 90 seconds, the reality can vary according to passenger behavior, compliance with instructions, perceived danger to life and environmental conditions.

Carry-on Baggage and Evacuation

Cultural differences and passenger demographics can also play a part in behavior. The perception of many remains that cabin occupants will move rapidly to the exits during an evacuation; however, the reality observed is that movement toward the exits is slow. The requirement to leave baggage behind is not only enforced to speed up the flow of passengers within the cabin, but also to prevent injuries and increase passenger flow through the exits once they reach them.

It is well known that passengers frequently take carry-on baggage with them during an evacuation, and it is often indicated that airlines should do more to get the message across that this is not acceptable during an emergency.

During 2019, one airline introduced a safety demonstration video that uses cartoon animation to clearly emphasize the importance of following crew instructions and shows some potential consequences of taking carry-on baggage during an evacuation. The message is conveyed in a direct, yet nonconfrontational manner, hopefully leading to correct behavior should an emergency arise.

When passengers do not comply with the instructions to leave baggage behind, crew are faced with the dilemma of forcibly removing the bags and putting them somewhere so as to not obstruct the flow of passengers through the exits, throwing them outside the aircraft and potentially injuring others, or letting the passenger take the bags with them and potentially injuring themselves and/or others during evacuation.

Suggestions of centralized locking of overhead bins have been discussed with researchers, airlines and manufacturers throughout 2019, but the issue is complex. Adding such a barrier to this particular behavior might add different risks as passengers seek to bypass the impact of having their carry-on baggage unobtainable at any time. IATA continues to be involved in all discussions on this matter at the industry level in the hope that workable solutions, which do not simply shift these risks or unintentionally introduce others, can be found. It remains clear from the evidence that passengers need to fully understand the potential consequences of prioritizing their personal effects during emergency situations and that it is not the sole responsibility of operators to ensure this message is understood.

Mitigating Safety Risks within Seat Design

Previous analysis of safety reports submitted to IATA's Global Aviation Data Management programs indicated that passengers frequently drop small portable electronic devices into premium seat mechanisms. Of these, around half become damaged and around one-third of those damaged experience thermal runaway.

IATA strongly recommends that airlines include a warning within their passenger briefings to be careful with their devices and, if they lose them, to advise cabin crew immediately without moving the seat.

Of course, making an announcement to warn passengers is only one strategy to mitigate the risk. The root cause of the hazard is often that the seat design allows devices to fall into the gaps in normal and expected use of the seat.

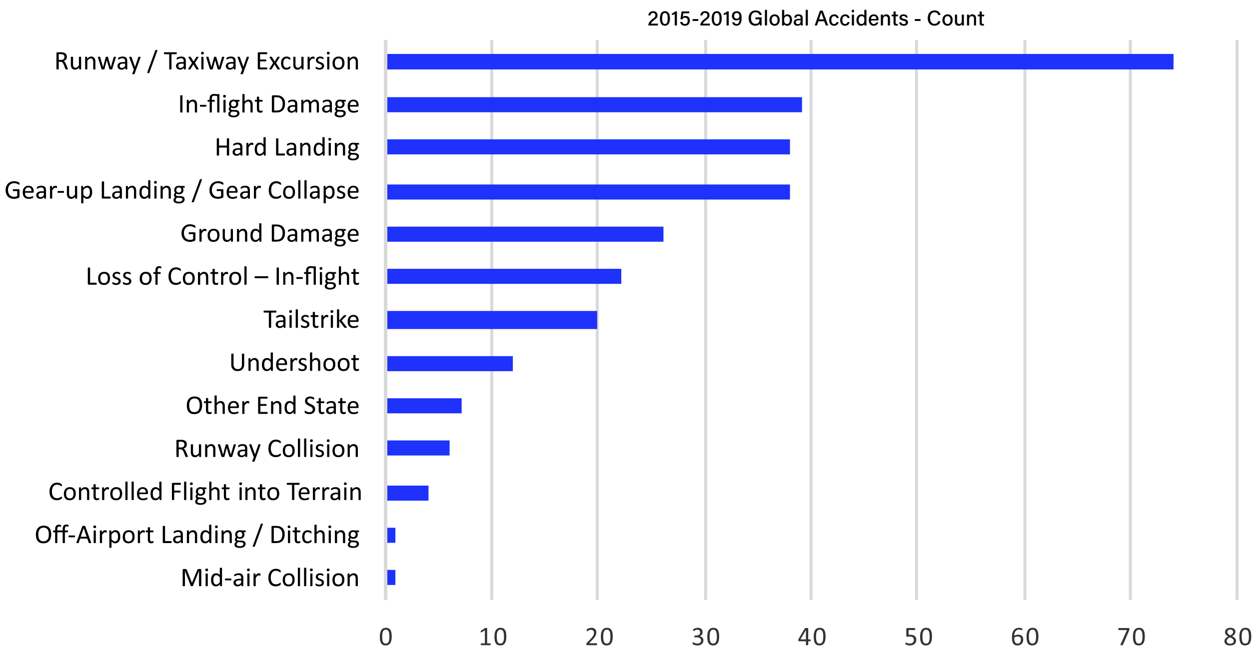
Changing the seat design to install practical and useful stowage areas for these devices is another useful step toward mitigating the risk. In 2019, IATA Cabin Safety worked to promote the risk to seat designers and seat design standards organizations so that mitigation can be included at the early design stages, saving costly mistakes and potential retrofit design changes. The result of these efforts can be found in the Best Practice Guide for Cabin Interior Retrofits and EIS published in February 2019.

8

Report Findings

TOP FINDINGS: 2015-2019

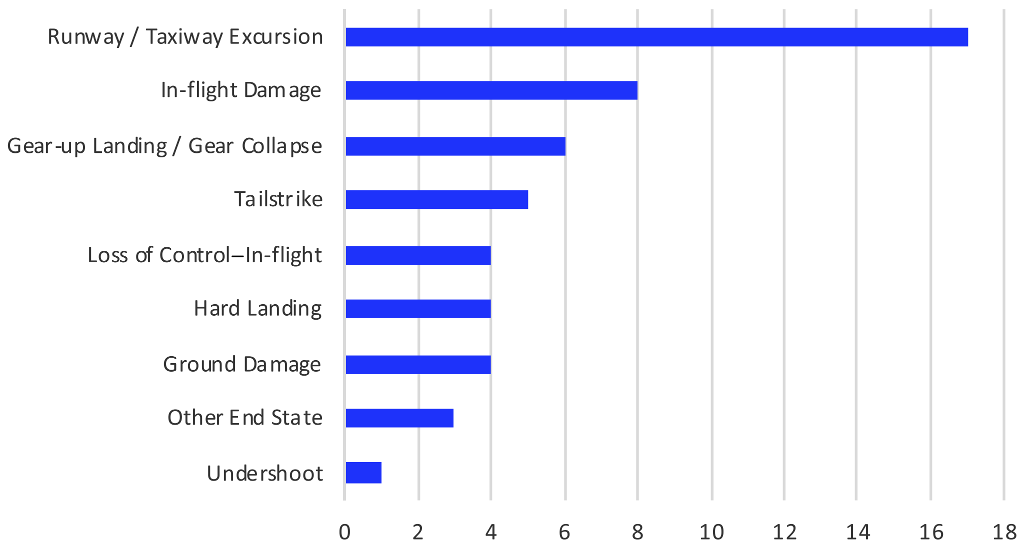
Covering a five-year period, the 2015-2019 Accident End State Distribution, as assigned by the Accident Classification Technical Group (ACTG), was as follows:



2015-2019 Accident End State Distribution

The 2019 safety performance of the commercial airline industry shows continuing improvements compared to 2018 and to the average of the preceding five years (2015-2019).

The Accident End State Distribution of the 53 accidents that occurred in 2019, as assigned by the ACTG, was as follows:



The accident end states with associated fatalities in 2019 were:

- Loss of Control – In-flight (4) with 191 fatalities
- Runway Excursion (2) with 3 fatalities
- Hard Landing (1) with 41 fatalities
- Other End State (1) with 5 fatalities

With a full breakdown of each accident end state to follow, the table below provides an overview of 2019's performance compared to the five-year average.

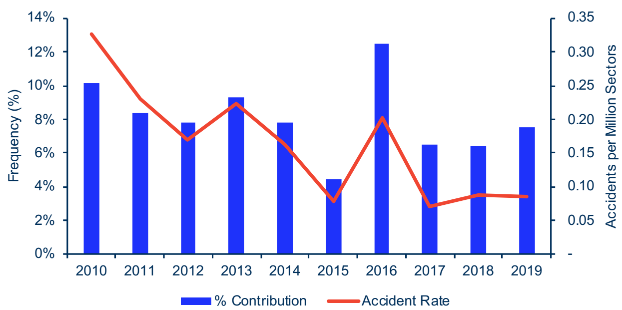
2019 vs 2015-2019

	2019	Comparison vs 5Y	5 Y Average (2015-2019)
Number of accidents	53	▼	58
% of accidents involving IATA members	42%	▲	39%
% of fatal accidents	15%	▲	13%
% aircraft propulsion - Jet	58%	▼	66%
% aircraft propulsion - Turboprop	42%	▲	34%
% type of operations - Passenger	91%	▲	82%
% type of operations - Cargo	9%	▼	17%
% Hull losses	21%	▼	25%

Loss of Control – In-flight

Loss of aircraft control while in flight. The expected flight path could not be maintained, or a stall that was not recovered.

From 2015 to 2019, 22 Loss of Control – In-flight (LOC-I) accidents have caused a total of 780 fatalities. The four LOC-I accidents in 2019 resulted in 191 fatalities. Described another way, in 2019, LOC-I accounted for 8% of accidents, but resulted in 80% of onboard fatalities. As such, LOC-I has retained its status of having a high fatality risk.



Accident rate and percentage of all accidents attributed to LOC-I, 2010-2019

The ACTG found no common threats between 2019's LOC-I accidents. Coded threats included adverse weather conditions, spatial disorientation, as well as complex aircraft systems and systems degradations. Where these threats were not managed by the flight crew, they manifested as flight crew errors, of which there were some common themes. Manual handling errors/ flight controls was determined in two of the four accidents.

The IATA publication Loss of Control – In-flight, Beyond the Control of Pilots, 1st Edition, Section 3.2 Management – Some Considerations describes the responsibilities for LOC-I at an organizational level, and states:

"Management decisions may not have an immediate effect on the outcome of every flight, but potentially they can play a role in an accident long before it occurs. LOC-I accidents do not conform to a clear pattern and there have been multiple different reasons why pilots have lost control of their aircraft. These include:

- Flawed maintenance practices leading to system malfunctions.
- Inadequate flight crew selection and training standards (e.g., behavioral deficiencies, lack of training with respect to illusions, high g-load environment, managing unexpected situations).
- Operating procedures (e.g., erosion of manual flying skills or deficiencies in handling automation).
- Environmental conditions (e.g., meteorological phenomena that can cause aircraft upsets).
- Air traffic environment (e.g., wake vortices).
- If there is a common factor in LOC-I accidents, it appears to be the 'startle factor', when the situation facing the pilot is unexpected and/or unrecognized and he/she is unable to devise and implement a solution in the time available".

Further reading can be found here.

Furthermore, undesired aircraft states are defined as flight crew-induced states that reduce safety margins, but are still considered to be recoverable. Common across the coded accidents was vertical/lateral speed deviations, flight control/ automation and operations outside of aircraft limitations, which were found in two of the four accidents.

Countermeasures across the LOC-I accidents found that in-flight decision-making and captain should show leadership were a recurrent theme in all four accidents. If these countermeasures were demonstrated, they may have led to a different outcome. ACTG has cited in-flight decisions and leadership as contributing factors in many of the accidents. ACTG has added a recommendation to address this issue at the end of Section 8.

The common contributing factors cited in all LOC-I accidents that occurred in 2019 are listed in the following table:

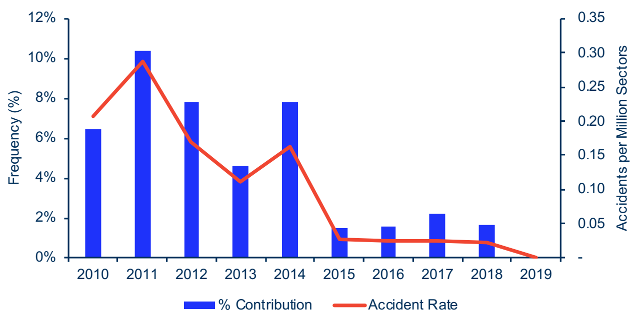
Latent Conditions	Flight Ops: Training systems Regulatory oversight Safety management Selection systems
Threats	Meteorology Airport facilities Birds Icing conditions Operational pressure
Errors	Manual handling / Flight controls Abnormal checklist Intentional SOP adherence/SOP cross-verification
Undesired Aircraft States	Abrupt aircraft control Flight controls/ Automation Operation outside aircraft limitations Vertical/Lateral/Speed deviation
Countermeasures	In-flight decision-making Captain should show leadership Automation management Overall crew performance

A detailed interactive analysis report on LOC-I accidents using 10-year data can be found here.

Controlled Flight into Terrain

In-flight collision with terrain, water or obstacle without indication of loss of control. Cases where an aircraft hits an obstacle (e.g., power lines) on final approach, performs a go-around and successfully lands will also count toward Controlled Flight into Terrain (CFIT).

Over the last five years, from 2015 to 2019, four CFIT accidents have occurred, three of which were fatal causing a total of 124 fatalities (75% of the CFIT accidents were on turboprop aircraft). In 2019, there were zero CFIT accidents. In 2018, there was one fatal CFIT accident, resulting in 66 fatalities. The graph below indicates the percentage of all accidents that were CFIT over the past 10 years.



Accident rate and percentage of all accidents attributed to CFIT, 2010-2019

Linked to the outcomes of the accidents was regulatory oversight (latent conditions), which was cited in all four CFIT accidents. Also common to all the coded CFIT events was safety management and Flight Operations (FOPs): SOPs and checking, highlighting the importance of robust training systems.

On review of all CFIT accident threats, adverse weather conditions, lack of visual reference (poor visibility/IMC) accounted for 75% of the categorized threats for all CFIT accidents since 2015. While looking at the errors, intentional noncompliance with SOPs accounted for 100% of the categorized errors for the same accidents. The undesired aircraft states have strong correlation in the CFIT category, and included unnecessary weather penetration and abrupt aircraft control. Critically for CFIT accidents, controlled flight toward terrain accounted for the final main undesired aircraft state.

The data also shows under the undesired aircraft state that 50% of CFIT accidents had vertical, lateral or speed deviations as a contributing factor. One method to provide pilots with a greater level of safety is through enhanced situational awareness and more reliable warnings of possible terrain conflicts, such as EGPWS that is equipped with accurate navigation systems like GPS for both navigation and terrain surveillance.

The common contributing factors cited in all four accidents that occurred during the period 2015-2019, with zero CFIT accidents in 2019, are listed in the following table.

Latent Conditions	Regulatory oversight Flight Ops: Ops and checking Safety management Selection systems
Threats	Lack of visual reference Meteorology Poor visibility/IMC Ground-based nav aid malfunction or not available Operational pressure
Errors	Intentional SOP adherence/SOP cross-verification Callouts Failure to go around Manual handling/Flight controls
Undesired Aircraft States	Controlled flight toward terrain Unnecessary weather penetration Vertical/Lateral/Speed deviation Abrupt aircraft control Continued landing after unstable approach
Countermeasures	In-flight decision-making Monitor/Cross-check Overall crew performance Captain should show leadership First Officer (FO) is assertive when necessary

Poor Crew Resource Management (CRM) was also a frequent contributing factor cited in CFIT accidents. Effective crew coordination and crew performance, and general CRM principles and behaviors, can reduce pilots' workload and decrease the probability of human errors.

Pilot performance remains a major factor in CFIT accidents despite the efforts to mitigate risk, handling and/or inappropriate actions by flight crew continue to be emphasized. Enhancing pilot performance and competency, both in normal and abnormal circumstances, will empower pilots to intervene with greater confidence and competence to prevent any environmental threats and hazards that could lead to high-risk outcomes.

Operators must ensure that their training programs robustly address potential deficiencies, environmental, technical/nontechnical factors such as human factors, air carrier's SOPs, fatigue, and CRM techniques for the most effective prevention and threat mitigation strategies, and any occurrence reporting that affect their performance. Training, whether it is academic or simulator training, should allow pilots to experience realistic situations that require timely decisions and correct responses. Simulator training should also be given to provide pilots the opportunity to practice CFIT prevention strategies, including escape maneuvering. Such training should be given to pilots during initial, transition and recurrent training.

Another important element of continued improvement in CFIT accidents is the collection and sharing of flight data to identify hazards ahead of time and mitigate those risks that can lead to an accident. The use of Flight Data Management (FDM) is essential as it identifies potential hazards in flight operations and provides accurate quantitative data. It is also the best-known indicator of undesired aircraft states like operation outside aircraft limitation.

A detailed interactive analysis report on CFIT accidents using 10-year data can be found here.

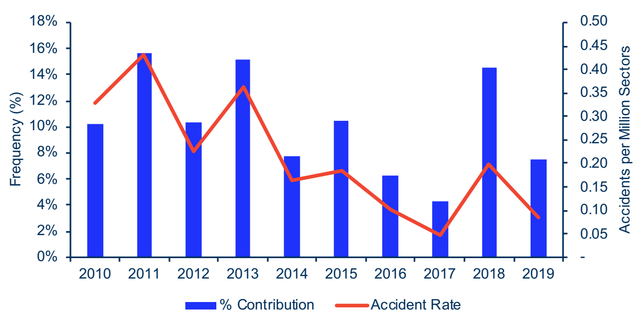
Ground Damage Accidents

Damage to aircraft occurring while on the ground, including occurrences during (or as a result of) ground handling operations, collision while taxiing to or from a runway in use (excluding a runway collision), foreign object damage, and fire/smoke/fume.

As specified in Annex 1, IATA has several ways to classify an accident, one of which is by the cost of the damage to the aircraft: the aircraft has sustained major structural damage that adversely affects the structural strength, performance or flight characteristics of the aircraft and would normally require major repair or replacement of the affected component exceeding $1 million USD or 10% of the aircraft's hull reserve value, whichever is lower, or the aircraft has been declared a hull loss.

Over the last five years, from 2015 to 2019, 26 ground damage accidents have occurred, with zero fatalities. 92% of the accidents were on jet aircraft. In 2019, there were four ground damage accidents, down from 9 accidents in 2018. There were no hull losses since 2016, however, there were two in 2015.

The graph below indicates the rate and percentage of all over the past ten years.



Accident rate and percentage of all accidents attributed to ground damage, 2010-2019

Looking at the common factors of the four ground damage accidents in 2019, in the latent conditions for Ground Operations: SOPs and checking and safety management were cited as contributing factors in 67% of all ground damage accidents in 2019. Looking at the different threats, 33% were attributed to adverse weather, poor visibility/IMC, traffic, vehicle and operational pressure.

The common contributing factors cited in ground damage accidents in 2019 are as shown in the following table:

Latent Conditions	Ground Operations Ground Ops: SOPs and checking Safety management
Threats	Meteorology Poor visibility/IMC Traffic Vehicle Ground events Operational pressure
Airline	—
Undesired Aircraft States	—
Countermeasures	—

Other threats found in accidents were classified by ACTG from the perspective of both service providers and airports/regulators.

Service Providers threats:

- High turnover of personnel
- Lack of just culture implementation
- Lack of SMS implementation, or no interface with airline SMS
- Operational pressure / operational growth with no infrastructure growth
- Insufficient training / qualifications do not expire / no recurrent training
- Lack of technological innovation on GSE

Airports/Regulators threats:

- Infrastructure deficiencies and outdated aeronautical information publication (AIP)
- Unofficial communication of threats like use of safety bulletins instead of Notices to Airmen (NOTAMs)
- No endorsement of a higher level of safety standards like ISAGO/IGOM

After internal deliberations, the ACTG decided to propose the following recommendations to airlines, service providers, airports and regulators to reduce the number and severity of ground damage accidents:

1. For service providers:

- Improve employee retention and implement periodic review of their qualifications/skills
- Implementation of SMS and the ISAGO certification

– Participation in Data Sharing programs like IATAs Incident Data eXchange (IDX)

– Automation of processes and technology

– Process standardization for different clients through the adoption of IGOM

2. For airlines:

– Supervision and process standardization through the adoption of IGOM

– Data-driven oversight of providers, benchmarking and risk identification through participation on Data Sharing programs like IATA's IDX

– Hazard alerts to crews and ramp supervisors/ managers

– Empowerment of airline ramp supervisors/managers

3. For airports and regulators:

– Endorse and recognize international certifications like the ISAGO

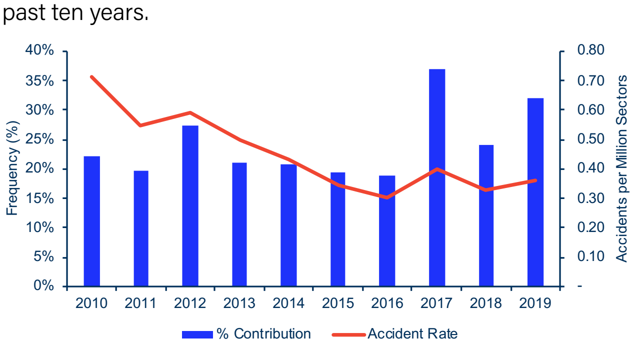
Runway/Taxiway Excursions

An overrun off the runway surface. A veer off the runway surface. A departure from the taxiway surface.

Runway/taxiway excursions remained the most frequently occurring accident end state. Over the last five years (2015–2019), there have been 74 runway/taxiway excursion accidents. Despite their frequency, associated hull losses and fatalities are rare, and as such, runway excursion fatality risk is comparatively low. In 2019, there were 17 runway excursion accidents, including 10 runway veer-offs and 7 runway overruns. There were 15 runway/taxiway excursion accidents in 2018.

All 17 runway/taxiway excursions in 2019 were operated on passenger flights, two of which were fatal accidents, causing three fatalities. Eleven of the accidents were operated on turboprop aircraft.

The graph below indicates the accident rate and percentage of all accidents that were runway/taxiway excursions over the past ten years.



Accident rate and percentage of all accidents attributed to runway/taxiway excursions, 2010-2019

The common contributing factors cited in all runway/taxiway excursions accidents that occurred in 2019 are listed in the following table.

Latent Conditions	Regulatory oversight Safety management Flight operations Maintenance operations Maintenance Ops: SOPs and checking
Threats	Meteorology Airport facilities Wind/wind shear/gusty wind Contaminated runways Aircraft malfunction Operational pressure
Errors	Manual handling/flight controls SOP adherence/SOP cross-verification Failure to go around Intentional Failure to go around after destabilization on approach
Undesired Aircraft States	Long/floated/bounced/firm/off-center/crabbed landing Vertical/lateral/speed deviation Unstable approach Continued landing after unstable approach Unnecessary weather penetration
Countermeasures	Overall crew performance Taxiway/runway management Monitor/cross-check In-flight decision-making/ contingency Captain should show leadership

From the contributory factors, minimizing human factors in flying skills and improving timely decision-making are vital to reducing runway excursions. Incorrect flight crew techniques and decision errors are also common factors contributing to runway excursion accidents.

Other factors may affect flight crew performance, such as:

- Deviation from the approach path or glideslope during final approach (unstable approach).
- Incorrect assessment of landing distance for prevailing weather.
- Delayed or incorrect pilot action in the use of braking devices.
- Landing too fast, too far down the runway, or bounced landing.
- Deficiencies in piloting skills or judgment regarding control of the aircraft.
- Lack of/late decision-making, in particular, but not only, during adverse weather conditions affecting the airport.

Furthermore, runway contamination and related issues represent major runway excursion risk factors. This points to the urgent need for a common understanding of the complex interaction between factors affecting the use and performance of aircraft braking systems. This involves a wide range of factors, including the reporting of runway conditions in a standardized manner such that pilots are able to accurately determine aircraft takeoff and landing performance. The development of a Global Reporting Format (GRF) for assessing and reporting runway surface conditions will significantly reduce the risks associated with runway contamination. The GRF will assist pilots to correctly carry out their landing and takeoff performance calculations for wet or contaminated runways. This GRF methodology relies on the use of the Runway Condition Report (RCR), which is intended to put in place a common language among all participants of the system that is based on the impact on aircraft performance of the runway surface condition. RCR depends on the Runway Condition Assessment Matrix (RCAM) and Runway Condition Code (RWYCC) ranging from 0 for a very slippery surface to 6 for a dry surface.

Runway construction, inadequate airport facilities and landing overrun safety areas, ditches, berms, building locations and 'no overrun' were all indicated as factors to runway excursion accidents. With the recognition that runway excursions do occur, it falls to airport operators to ensure the likelihood of aircraft damage and injuries is minimized. A significant number of accidents analyzed included the factor 'inadequate overrun area' and much of the aircraft damage was the result of the obstacles encountered after the aircraft left the runway. Every effort must be made, as indicated in the Global Runway Safety Action Plan (GRSAP), to ensure all runway ends have a Runway End Safety Area (RESA), as required by ICAO Annex 14 Vol I, or appropriate mitigations such as arresting systems for aircraft overruns.

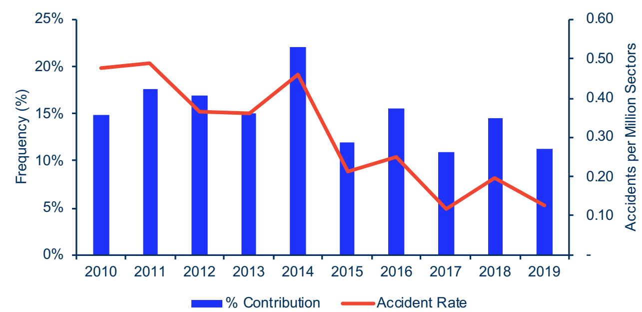
Another important element of continued improvement in runway/taxiway excursion accidents is the collection and sharing of flight data to identify hazards ahead of time and mitigate risks that can lead to an accident. It is important to deal with runway/taxiway excursion at the incident prevention level. The use of FDM is essential as it identifies potential hazards in flight operations and provides accurate quantitative data. FDM provides insight and better understanding regarding the circumstances behind an incident. Trend analysis can be used to support and modify operational procedures and enhance training programs. IATA encourages operators to produce standardized FDM safety measures and precursors related to potential runway/taxiway excursion accidents. These include unstable approaches, long/floated landing, long flare, tailwind, speed loss between threshold and touchdown, late/incorrect use of brakes, late/incorrect use of reverse thrust, etc. With the established standardized FDM, operators can monitor aircraft parameters and identify common factors leading to runway/taxiway excursion events. Furthermore, FDM will enable operators to identify trends on runway/taxiway excursion events, and enable them to review procedures and training programs to reduce such events. FDM tools should be used as a primary source whenever possible.

Gear-up Landing / Gear Collapse

Any gear-up/collapse landing resulting in substantial damage (without a runway excursion).

Gear-up/collapse landings went down to six in 2019 from nine accidents in 2018 and caused zero fatalities. This is consistent with data over the past 10 years, which found that from 2010 to 2019 there were a total of 114 gear-up/collapse landings, which caused zero fatalities. Of the operators that experienced a gear-up/collapse landing in 2019, five occurred on jet aircraft and one on turboprop aircraft; none resulted in a hull loss.

The graph below indicates the accident rate and percentage of all accidents that were gear-up/collapse landings over the past ten years.



Accident rate and percentage of all accidents attributed to gear-up/collapse landings, 2010-2019

While this accident end state focuses on one type of aircraft technical failure, other common contributing factors were also cited in the six accidents as shown in the following table.

Latent Conditions	Maintenance operations Maintenance Ops: SOPs and checking Flight Ops: SOPs and checking Regulatory oversight
Threats	Aircraft malfunction Gear / Tire Maintenance events Electrical power generation failure Hydraulic system failure
Errors	Abnormal checklist Checklist Intentional SOP Adherence/SOP cross-verification Systems/radios/instruments
Undesired Aircraft States	Systems
Countermeasures	Overall crew performance Taxiway/runway management Monitor/cross-check Workload management Pro-active: In-flight decision-making Captain should show leadership

Underscoring the accidents where maintenance activities were a common factor, checking and training, and SOPs were deficient at an organizational level (latent conditions). These results were as follows:

- Maintenance Ops: SOPs and checking were cited in 67% of accidents
- Flight Ops: SOPs and checking contributed to 33% of all 2019 accidents under this category

The following pilot competencies were identified as weak countermeasures to manage the threats and errors, and to recover from the undesired aircraft state:

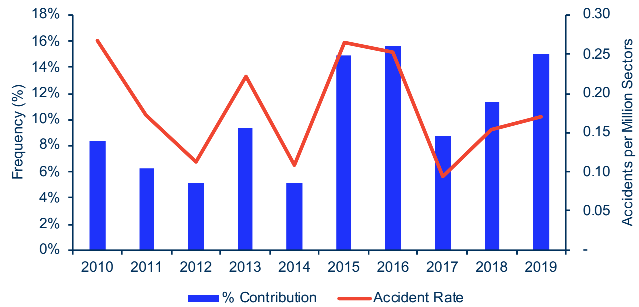
- Problem-solving and decision-making
- Situational awareness

In-flight Damage

Damage while airborne, including weather-related events, technical failures, bird strikes and fire/smoke/fume.

In-flight damage events increased to eight nonfatal accidents in 2019 (from seven in 2018, including one fatal accident that caused one fatality). Of the 39 accidents from 2015 to 2019, two were fatal, resulting in two fatalities. Those two fatal accidents occurred in 2016 and 2018. Of the eight accidents in 2019, five occurred on jet aircraft and one resulted in a hull loss.

The graph below indicates the accident rate and percentage of all accidents that were in-flight damage over the past ten years.



Accident rate and percentage of all accidents attributed to in-flight damage, 2010-2019

The common contributing factors cited in all In-flight Damage accidents that occurred in 2019 are listed in the following table.

ACTG Categorization of 2019 In-flight Damage Accidents

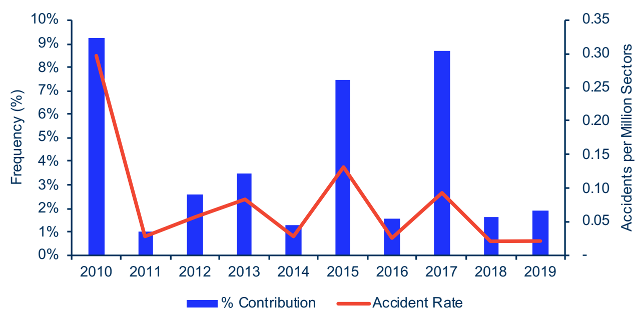
Latent Conditions	Regulatory oversight Safety management Design Management decision
Threats	Wildlife/Bird/Foreign object Airport facilities Meteorology Airport perimeter control/fencing Birds Aircraft malfunction Contained engine failure / Powerplant malfunction
Errors	Manual handling / flight controls Failure to go around Failure to go around after abnormal runway contact Intentional SOP adherence/SOP cross-verification
Undesired Aircraft States	Abrupt aircraft control Unnecessary weather penetration Long/floated/bounced/firm/off-center/crabbed land Vertical/lateral/speed deviation
Countermeasures	—

Undershoot

Touchdown off the runway surface

A single nonfatal undershoot accident occurred in 2019. Twelve accidents occurred in this category from 2015 to 2019, three of which were fatal causing a total of seven fatalities.

The graph below indicates the accident rate and percentage of all accidents that were undershoots over the past ten years.



Accident rate and percentage of all accidents attributed to undershoots, 2010-2019

Under the accident classification taxonomy, meteorological events are listed in two categories: threats and undesired aircraft state. Under the threat category, meteorology encompasses the following events:

The common contributing factors cited in all 12 accidents that occurred during the period 2015-2019 are listed in the following table.

Latent Conditions	Regulatory oversight Safety management Flight Ops: SOPs and checking Management decisions
Threats	Meteorology Ground-based nav aid malfunction or not available Poor visibility/IMC Wind/Wind shear/Gusty wind Operational pressure Other
Errors	Manual handling/flight controls SOP adherence/SOP cross-verification Intentional Failure to go around Pilot-to-pilot communication
Undesired Aircraft States	Vertical and lateral speed deviation Unnecessary weather penetration Continued landing after unstable approach Unstable approach Controlled flight toward terrain
Countermeasures	Overall crew performance Monitor/cross-check FO is assertive when necessary Captain should show leadership Automation management

Proposed Countermeasures

Every year, the ACTG classifies accidents and, with the benefit of hindsight, determines actions or measures that could have been taken to prevent an accident. These proposed countermeasures can include issues within an organization or country, or involve the performance of frontline personnel, such as pilots or ground personnel. They are valid for accidents involving both jet and turboprop aircraft.

This section presents countermeasures and the percentage of accidents that the ACTG analysis determined could have been prevented if the countermeasures had been actioned. The intention is to help operators, regulators and flight crews enhance safety by implementing and strengthening these countermeasures.

Countermeasures are aimed at two levels:

- The operator or State responsible for oversight. These countermeasures are based on activities, processes and systemic issues internal to the airline operation or State's oversight activities.
- Flight crew. These countermeasures are to help flight crew manage threats and errors during operations.

COUNTERMEASURES FOR THE OPERATOR AND THE STATE

Subject	Description	% of accidents where countermeasures could have been effective (2015-2019)
Regulatory oversight by the State of the Operator	States must be responsible for establishing a safety program to achieve an acceptable level of safety, encompassing the following responsibilities: ▪ Safety regulation ▪ Safety oversight ▪ Accident/incident investigation ▪ Mandatory/voluntary reporting systems ▪ Safety data analysis and exchange ▪ Safety assurance ▪ Safety promotion	**32%**
Safety Management System (Operator)	The operator should implement a safety management system accepted by the State that, as a minimum: ▪ Identifies safety hazards ▪ Ensures that remedial action necessary to maintain an acceptable level of safety is implemented ▪ Provides for continuous monitoring and regular assessment of the safety level achieved ▪ Aims to make continuous improvements to the overall level of safety	**31%**
Flight operations: Standard Operating Procedures and Checking	▪ Omitted training ▪ Language skills deficiencies ▪ Qualifications and experience of flight crews ▪ Operational needs leading to training reductions ▪ Deficiencies in assessment of training or training resources, such as manuals or computer-based training devices	**15%**

COUNTERMEASURES FOR FLIGHT CREWS

Subject	Description	% of accidents where countermeasures could have been effective (2015-2019)
Overall crew performance	Overall, crew members should perform well as risk managers. Includes flight, cabin, and ground crew as well as their interactions with Air Traffic Control	**27%**
Monitor/Cross-check	Crewmembers should actively monitor and cross-check the flight path, aircraft performance, systems performance and the performance of other crewmembers, as well as verify the aircraft position, settings and crew actions	**20%**
In-flight decision-making/ Contingency management	Crewmembers should develop effective strategies to manage threats to safety	**14%**
Leadership	▪ Captain should show leadership and coordinate flight deck activities ▪ First Officer is assertive when necessary and able to take over as the leader	**13%**

SYNTHETIC TRAINING DEVICES

Background

Aircraft manufacturers and training organizations make assumptions as to the performance of the average pilot. Each operator needs to realistically assess if their pilot community meets these assumptions for the aircraft being operated and tailor their training program accordingly.

Synthetic training devices such as full flight simulators and, likely in the future, virtual reality, are heavily utilized to train pilots. For many reasons, such as economic pressure, pilots are less and less exposed to real-world conditions in training. Even experienced pilots can face challenges in that respect (e.g., because of very long sectors, lack of hands-on experience on the flight controls, or when being paired with a very inexperienced pilot on type). In 2019, we saw several long and/or bounced landings, both for turboprops and jets, which resulted in runway excursions. In many of the events, gusty winds and pilots not being able to cope with them, or their failure to go around, were identified as contributing factors. Most of today's simulators do not give a realistic test in these conditions.

Discussion

The ACTG discussed if today's Flight Simulation Training Devices (FSS-D zero flight time simulators) can simulate conditions and handling characteristics of airplanes close to the ground. Although simulator certification standards (e.g., CS-FSTD) demand accurate ground modeling, the perception of the pilot community is that bounces, hard landings and landings in gusty cross-winds in the simulator do not reflect aircraft behavior well enough to rely on them as a primary training tool.

Also, with the sheer number of systems installed in aircraft, it is impossible to recreate all combinations of failures. Therefore, a more general approach to problem-solving is required. This topic is addressed in more detail in the section on in-flight decision-making and addresses ongoing leadership training (e.g., through group exercises).

Better understanding of systems and their interaction would have prevented some of the accidents. The consequences of actions being taken during problem-solving should be better understood by the pilots operating the system.

The goal of training is not to complete a course within a given time, but establish competencies that allow pilots to safely operate their aircraft.

Recommendations to Operators

Risk analysis of what minimum training is required for a pilot is based on the assumptions that the manufacturers make on pilot behavior, skills and knowledge. In some cases, operators may have to exceed minimum training requirements simply because their pilot population (i.e., demographics, previous experience) does not meet the expectations/assumptions.

Realistic assessment of the amount of training required should be based on the actual level of performance achieved by the pilot.

Recommendations to Industry

Explore new approaches to refine simulator fidelity (e.g., by integrating emerging technologies like Artificial Intelligence with FDM), allowing for continuous improvement in the simulator data package and modelling of simulations, at reasonable cost and based on day-to-day real-life data.

Explore the possibility of using safety data (e.g., FDM, ASR) to design simulator sessions so that the pilots will be trained using realistic scenarios that reflect the airline context of operations. This initiative would complement evidenced-based training by exposing the pilots to operator-specific threats encountered in operations.

IN-FLIGHT DECISION-MAKING

Background

There have been several accidents where leadership and in-flight decision-making were identified as contributing factors, not only during the time when the airplane is in the air, but also when the crew made decisions on the ground (i.e., deicing, uploading enough fuel).

With financial pressure on airlines mounting and airports being more and more congested, the potential for degraded operational safety will increase.

At many airlines, the progress to command is more rapid now than in the past. The result of this is pilots assuming command at an earlier point in their career, with less operational experience and exposure. This earlier transition highlights the need for robust training of all pilots assuming command.

Discussion

Many airlines offer strategies to their pilots for decision-making in abnormal conditions and failure cases. Often, they are sound concepts based on TEM models and they are demonstrated to crews on a regular basis. However, very few strategies can be found for normal operations. The airline industry must seek a more collaborative approach to develop better decision-making skills for effective leadership and cockpit management.

Flight crew briefings (in particular departure and arrival briefings) are a strong TEM strategy for normal operations. A revision of Crew Briefing in Chapter 3, ICAO Annex 6 as proposed by IATA in 2019 is a first step to develop better TEM-focused briefings

Regulators, airline operators, unions and other stakeholders must support the development of effective decision-making skills by allocating proper financial and hard resources.

Pilots and all operational employees have a responsibility to make the best use of the resources provided to them, by applying these strategies effectively.

As seen throughout this section, deficient or absent leadership was found to be a frequent contributing factor to 2019 accidents.

Recommendations to Operators

Equip crews and support the organizations behind them to be able to make considered, timely and risk-based decisions. This includes the selection, training and competence management of all safety critical staff. In-flight decision-making techniques prepare crews to plan well in advance to not be surprised by events and to mitigate them.

Some airlines have good experience with dedicated training to develop leadership skills, not only in Captain upgrade courses, but through ongoing personality development training programs, such as group exercises in team problem-solving in addition to regulatory requirements.

Recommendations to Industry

Implement revised crew briefings following TEM principles as proposed by revised ICAO Annex 6 Chapter 3.

Develop guidance material addressing what is required of a commander and how to train and assess the requirements. Such guidance material would help to produce a standardized training throughout the industry, while allowing for cultural and operational differences between airlines.

9

STEADES Analysis

Global Aviation Data Management UPDATE

CONTINUOUS IMPROVEMENT

In 2019, the GADM Team focused on upgrading all the global data exchange programs. These system upgrades were in response to feedback received from our industry users.

Complimentary to these system improvements, a review of internal processes and contract management was undertaken to further streamline the on-boarding process and minimize the time taken for participants to join.

The GADM Team will hold a series of user group feedback sessions in 2020 for all data exchange programs.

For more information, please visit the GADM website.

INCIDENT DATA EXCHANGE

The new Incident Data Exchange (IDX) was launched at the end of 2019 and a strategic rollout plan has been put in place to expedite on-boarding and have the new system up and running as soon as possible.

Users can expect to see STEADES and GDDB replaced by a vastly enhanced system providing a single portal to upload data and view industry safety and security data analytics.

The IDX program is a worldwide, aggregated, de-identified database of incident reports, including flight, cabin, and ground operations safety and security occurrences. It offers a secure environment providing participants with a seamless experience to view aggregated data against standards and benchmarked with other counterparts.

Safety and security information is shown using safety performance indicators, helping IDX participants to establish safety performance targets in accordance with ICAO requirements for SMS.

System benefits include the ability for users to:

- Highlight critical trends on a regional and global scale
- Benchmark themselves at the regional and global level
- Anticipate operational challenges and risks at specific airports
- Identify critical incident trends while setting targets for improvement
- Access comprehensive analysis integrating IATA subject matter expertise to provide:
  - In-depth safety and security analysis
  - Ready-to-use presentations to communicate key issues throughout the organization

The GADM Team has designed and implemented a new system capable of providing dual perspectives by allowing IATA to identify global safety and security issues, which may not be visible at the airline level, and allowing program members to identify specific areas of required safety and security improvement.

In early 2019, the GADM Team reached out to the leading industry SMS software providers to identify partnership opportunities to automate and streamline the data submission processes.

As a result, a workshop was hosted in IATA's Montreal headquarters to determine the best approach to modernizing the current data submission process. Additionally, the GADM Team participated in various industry meetings to increase collaboration while sharing industry best practices and harmonizing data collection processes.

ACCIDENT DATA EXCHANGE

The Accident Data Exchange (ADX) database has also undergone a major transformation.

ADX includes all commercial aviation accidents since 2005 that meet the IATA Accident Inclusion Guidelines. Each accident is validated and classified with the applicable contributing factors that contributed to the event. This classification is performed by safety experts from airlines, manufacturers and safety organizations.

All the accident data published in the annual IATA Safety Report is generated from ADX. GADM members are able to download all available accident reports once released.

In addition to accident counts, ADX provides rate-based information, which consists in normalizing accident numbers with global sectors to perform statistically relevant analysis.

GADM DATA SCIENCE

Data science has proven its value by leveraging big data to develop solutions for business problems. As a result, the industry is experiencing a paradigm shift by opening the data sources and utilizing the benefits of sharing data. GADM has always supported members as the only global aviation safety database to follow the fast-changing trends and better serve the industry's needs. GADM can further enhance its capacity and coverage, deepen analytic capabilities and discover synergies between data programs by integrating data science technologies.

In June 2019, GADM presented a challenge "GADM Incident Report Classification" at the IATA Aviation Datathon in Athens. The proposed ideas demonstrated the value and plausibility of data science techniques to implement automated solutions to solve GADM's incident classification challenge. To further explore these opportunities, GADM has been in touch with the data science communities in universities, airlines, IT companies and other aviation organizations to share priorities and promote collaboration among the industry.

IATA has recently signed a partnership with Institute for Data Valorization (IVADO), a joint initiative of universities in Montreal with advanced expertise in statistics, artificial intelligence and operational research. IVADO offers industrial partners collaborative research with universities and supports knowledge transfer between academia and business. Through collaboration with local universities, GADM aims to develop machine learning models that can automate GADM operational processes or support human analysts in data collection, processing and risk identification, thus increasing database coverage with advanced analytics.

The inaugural data science project will be to initiate a research and development project using a Natural Language Processor (NLP) model that classifies incident reports based on the narrative summary, instead of relying on the human analysts, classification. In addition, through networking events and training, GADM seeks to acquire cutting-edge data analytic techniques to foster creative and innovative ideas.

The new IATA strategy in safety and security includes better risk identification through data availability, analysis and integration as one of the key strategic choices. After the successful release of the IDX platform and new FDX website in 2019, GADM is initiating its data science project starting in 2020 to actively seek new ideas and expand its horizons.

FLIGHT DATA CONNECT/EXCHANGE

IATA offers two unique flight data analysis programs that afford airlines an array of benefits: Flight Data Connect (FDC) and Flight Data Exchange (FDX).

FDC is an individual airline's focused analysis program while FDX is an aggregated flight data analysis program that allows for the consolidation of flight data for review and analysis to provide regional and global statistics for the industry.

In addition, due to the system linkages between FDC and FDX, customer airlines on the FDC program can have their data processed only once and subsequent de-identified data uploaded automatically into the FDX database. This seamless capability enables FDC customer airlines immediate benchmarking capability of their data against other operators in their region or globally.

FDC allows for direct interaction with an airline's crew rostering system using a system referred to as Achieved Flight Reports (AFRs). With these, an airline can review the number of flights processed against the actual flights flown. The system also enables an airline to link a flight to an individual pilot using a unique and de-identified marker that protects the identity of the crew. This is a feature that helps support data privacy as well as pilot union requirements for a flight data analysis program.

The FDC system currently enables users to export flight data in requisite formats to other service providers for engine health and fuel efficiency monitoring. In 2020, additional system linkages with FDX and other vendors will open more capabilities for FDC customers

In 2019, FDX was re-released onto a new platform/website. The program continued to expand and now has in excess of 70 members.

Primary changes have been the redevelopment of the FDX website, which is now driven through industry approved Safety Performance Indicators (SPIs), allowing airlines to be more proactive in their safety analysis. The new FDX platform was developed to be more user-friendly and easier to navigate, while providing participants with improved data visualizations and benchmarking capabilities. The refined filter criteria enables the ability to compare data by aircraft type and contributing events.

For further information about any of our programs, please contact us.

Maintenance Errors

BACKGROUND CONSIDERATIONS

The maintenance-related aircraft in-service occurrences are recognized as an area needing more detailed scrutiny in the context of the forecasted global fleet increase and the scale and evolution such an increase entails for aircraft maintenance activities. While the aircraft accident analysis of the last five years hardly concludes with a causal role identification of maintenance operations, a contributing role of latent conditions zeroing in on these operations is sometimes documented. The maintenance operations-related aircraft incidents represent an area of focus for the main participants in this activity: airlines, Maintenance, Repair and Overhaul organizations (MROs) and OEMs. This focus was also expressed by participants in the IATA Engineering and Maintenance Group (EMG), who set the priority direction to look into maintenance errors and their human factors link.

In 2019, IATA's GADM Team completed an analysis to better understand the magnitude of this issue. The analysis is subject to the disclaimer in Addendum F. The analysis was performed using STEADES data based on the following criteria:

- Date Range: Q1 2013 to Q2 2018, inclusively
- Phase of Flight: All phases
- Region: Worldwide
- Descriptors: Maintenance Standards; Panels/Plugs/Caps Insecure or Detached; Auxiliary Power Unit (APU) Left Running Unattended; Cross-Connection; Incorrect Parts/Fluids Used; Maintenance Equipment Left on Aircraft; Placarding Incorrect, and Technician/Mechanic English.
- Word Search: 'Error' in all other descriptors under Maintenance event type, such as: Aircraft Technical Log; Maintenance Other; Maintenance Inspection; Minimum Equipment List and Configuration Deviation List (MEL/CDL); Repetitive Significant Defect.

ANALYSIS OF MAINTENANCE ERRORS REPORTING

The analysis was completed using a five-year inclusive dataset across all phases of flight and on a worldwide scale. A review of the STEADES database produced an initial dataset of 9,572 reports over the five-year period. For this dataset, a statistical method was applied to extract a representative sample with the following statistical attributes:

- Margin of Error: 5%
- Confidence Level: 95%

The statistical formula used was derived from the normal distribution. Additionally, this method was based on parametric tests, which have a higher power than nonparametric tests. The TEM model was built into the analysis of the extracted representative sample of 370 reports out of 9,572 reports in the initial dataset.

DATA QUERY RESULTS

Review of the analyzed dataset (370 reports) resulted in the following distribution of reports:

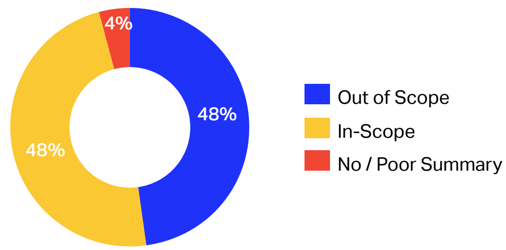


Figure 1: STEADES Dataset Overview

Only 'In-Scope' reports were considered as applicable for this analysis.

This distribution was equal to approximately 0.065 in-scope reports per 1,000 STEADES flights, which was consistent with one report per 15,307 STEADES flights.

Note: STEADES flights represent the number of all flights, operated by the STEADES program participating members within the intended timeframe.

When looking at the quarterly distribution of reports over the period of the analysis, we can observe that the trend is constant with two spikes: in Q3 2017 and Q1 2018.

Figure 2: STEADES Quarterly Distribution

A look at the region of operator distribution revealed that the highest distribution was for the European carriers. This was the case in both the percentage of reports as well as by the STEADES rate; 0.13 reports per 1,000 STEADES flights.

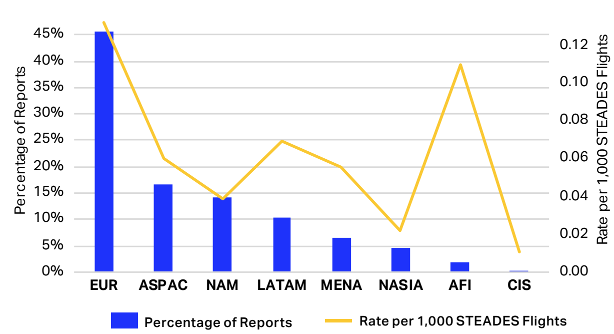


Figure 3: STEADES Regional Distribution

A noticeable variability factor exists in reported maintenance errors, not only between regions, but also between the countries of a given region. Such variability in percentage of reports is confirmed also by normalized (i.e., per 1,000 STEADES flights) statistics.

THREAT AND ERROR MANAGEMENT METHODOLOGY

For this analysis, TEM was applied to determine the contributing factors. TEM is an overarching safety concept regarding aviation operations and human performance.

The definitions applied to this maintenance errors study are as follows:

Threat: An event or error that occurs outside the influence of the maintenance crew, but which requires their attention and management to properly maintain safety margins.

Category	Definition
Human fatigue	Human fatigue due to workload
Language issue	Poor English proficiency of maintenance operators
Lack of qualification	The lack of maintenance personnel properly qualified for an intended task

Due to very limited threat information in the report narratives, the Threat category was excluded from this report.

Maintenance Error: An observed maintenance personnel deviation from organizational expectations or maintenance personnel intentions.

Category	Definition
Incorrect installation	Incorrect part installation during maintenance (part installed in an incorrect position)
Incomplete installation	Incomplete part installation by a maintenance operator
Aircraft damaged during maintenance	Aircraft damaged during maintenance
Equipment left on the aircraft	Equipment lost/left on the aircraft during maintenance operations
System operated unsafely	System operated unsafely during maintenance
Incorrect part/fluid used	Incorrect part/fluid used by a maintenance employee
Incorrect tool used	Incorrect tool used by a maintenance employee
Not following maintenance manual	Maintenance employee not properly following an aircraft maintenance manual
Unqualified personnel involved	Unqualified personnel involved in maintenance operations
Incorrect maintenance documentation	Maintenance employee not properly filling out or following write-ups in Aircraft Maintenance Logbook (AML)/MEL/CDL, with a direct impact on aircraft serviceability
Incorrect placarding	Incorrect placarding on the aircraft, attached by maintenance personnel
Maintenance Task / Check (MTC) task/check not accomplished properly	Maintenance check/task (other than part installation) not performed properly by maintenance personnel
Panels/Plugs open or removed	Panels/Plugs/Caps found open or removed

Undesired Aircraft State: An aircraft state that clearly reduces safety margins; a safety compromising situation that results from ineffective TEM. An UAS is recoverable.

Category	Definition
Flight delay	Flight is delayed due to a maintenance error
Go around	Go around procedure required due to a discovered maintenance error
Altitude deviation	Deviation from the intended aircraft altitude due to a maintenance error
Lateral deviation	Lateral deviation from the intended aircraft flight path due to a maintenance error
Speed deviation	Aircraft speed deviation due to a maintenance error
Unstable approach	Unstable approach due to a maintenance error
Incorrect aircraft configuration	Incorrect aircraft configuration in a system such as flight controls, automation, engine, or weight and balance (W&B) configuration due to a maintenance error

Countermeasures: Flight crew (FC) actions to overcome an unsafe situation related to a threat error and/or UAS.

Category	Definition
FC cancels taxi-out procedure	FC cancels a taxi-out procedure due to a maintenance error
FC cancels pushback procedure	FC cancels a pushback procedure due to a maintenance error
FC rejects takeoff	FC rejects a takeoff due to maintenance error
FC decides to land on an alternate airport	FC decides to land on an alternate airport due to a maintenance error
Speed deviation	Aircraft speed deviation due to a maintenance error

End State: An end state is a reportable event.

Category	Definition
Aircraft unable to fly	Aircraft forced to stay on the ground due to a maintenance error
Flight cancellation	Flight is cancelled due to a maintenance error

KEY FINDINGS

Report Type Distribution

- 70% (124) of in-scope reports were described from the Flight Crew point of view. These reports refer to maintenance errors taking place during daily checks or unscheduled maintenance when the aircraft is in service.
- 19% (33) of the reports refer to maintenance errors reported by Maintenance Crew that took place during scheduled or extensive maintenance when the aircraft is taken out of service.
- 11% (20) of the reports were not clear enough to be assigned to either of the two previous categories.

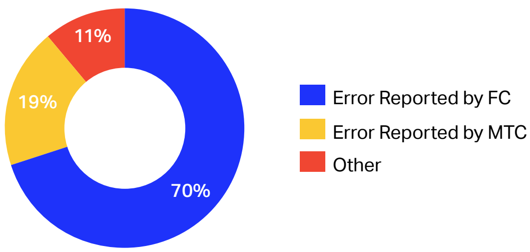


Figure 4 STEADES Report Type Distribution

Maintenance Errors Overview

50% (94) of errors were classified under the Manual Work (Other than Installation) category.

Errors have been grouped into several categories according to their subject matter.

- **Manual Work (Other than Installation)** covers: Equipment left on the aircraft, Task/check not accomplished properly, Panels/Plugs open or removed, Incorrect placarding, Aircraft damaged during MTC.
- **Documentation Error** covers: Incorrect MTC documentation.
- **Installation Error** covers: Incorrect installation, Incomplete installation, Incorrect part/fluid used.
- **Procedures Deviation** covers: Aircraft Maintenance Manual (AMM) not followed, Unqualified personnel involved, System operated unsafely.
- **Tooling Error** covers: Incorrect tool used.

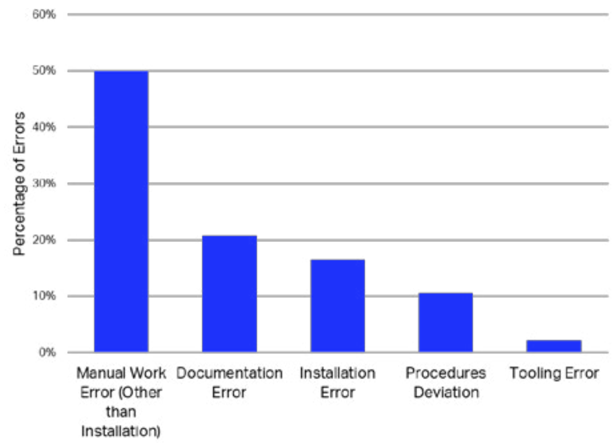


Figure 5: STEADES Maintenance Error Distribution

Undesired Aircraft States

Incorrect Aircraft Configuration (44%, 23)[1] was the most frequent UAS due to a maintenance error.

'No UAS', which is not shown in the graph, was noted in 79% (139) of coded reports.

- Within the reports containing an UAS (21%, 38):
  - **Flight Delay** was the second-highest UAS, representing 37% (19) of reports.
  - **Other** UAS covered (13%, 7):
    - Emergency Equipment Deficiency (4)
    - Aircraft Damaged (2)
    - Aircraft not Properly Closed (1)

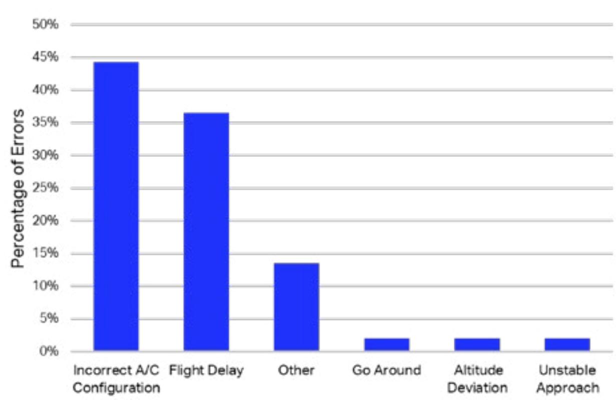


Figure 6: STEADES Undesired Aircraft State Distribution

Please note that the UAS (52) identified for this analysis are not mutually exclusive.

1 Incorrect aircraft configuration due to a maintenance error covers incorrect system, flight controls, automation, engine, or W&B configuration.

Countermeasures

83% (128) of maintenance errors were discovered either in the hangar before an aircraft release or during walk-around and checklist procedures prior the pushback.

This sequence shows when a maintenance error was noticed by the flight crew and their countermeasure to correct the error:

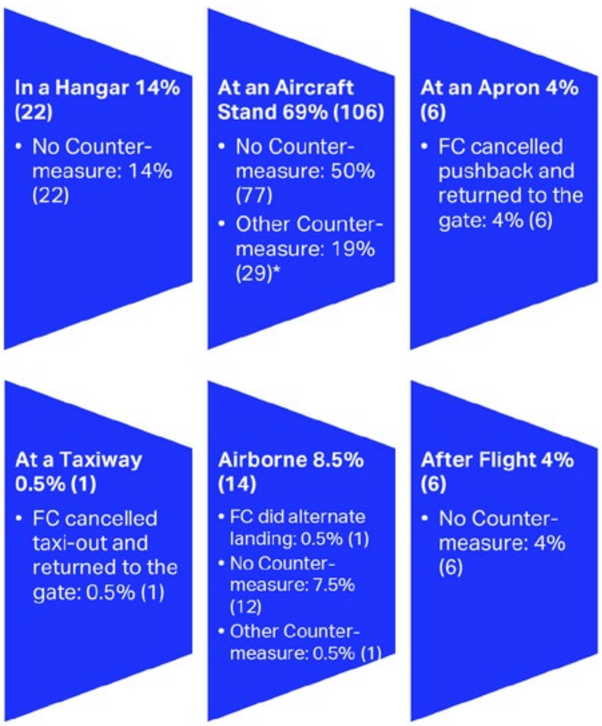


Figure 7: STEADES Countermeasure Distribution

* 'Other Countermeasures' covers various measures from the FC side such as: FC requested additional check (21), FC clarified with MTC (6), FC fixed the error (2), Passengers (PAX) disembarked (1), Flight cancelled (1).

** 22 reports and their respective errors, which did not specify the flight phase, were excluded from the chart.

End State

In **2%** (3) of reports, the aircraft was unable to fly (Aircraft on Ground AOG) due to a maintenance error.

In **98%** (174) of reports, an aircraft affected by a maintenance error was still able to operate the flight.

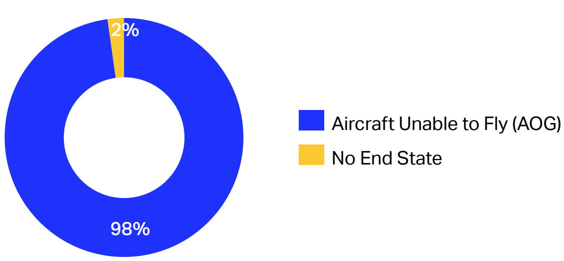


Figure 8: STEADES End State Distribution

Narrative Examples

Manual Work (Other than Installation)

"Maintenance staff while tightening the connector broke it and Cabin Press Selector had to be replaced."

"During the pre-flight walk around, the flight crew noticed that wheel number 4 was worn. ***The attending engineer was informed accordingly.*** *Flight Safety update: Engineering deferred the paint issue for a period of suitable ground time and considered the tire to be within limits, releasing the aircraft to service. However,* ***on return the attending engineer, the number 4 wheel was replaced.****"*

"Upon reaching the airplane it was noticed on the ***"doors" screen that the Main Electric Door was open.*** *The F/O during walk around confirmed it was open and unattended. Including no ladder nearby. Approximately 10 minutes prior to departure time, after the MRD was received* ***a call was made to SF Maintenance*** *about the door being open. A security check was also requested at that time of the electrical compartment.* ***A mechanic came out and closed the door.****"*

Documentation Error

"Inoperative potable water system treated as non MEL item by engineer. *When Flight Crew were taking the aircraft over from MX team, information about inoperative potable water system was exchanged. However MX crew told explicitly that this is not an MEL item and therefore is deferred to technical log as "Deferred Defect Item" not MEL. [...] During flight it was discovered though that there exists relevant MEL position. Thus after flight Work-order was opened, MCC notified and aircraft eventually dispatched in accordance with proper MEL number."*

"MEL actioned incorrectly. *CB found not pulled. MEL 28-15-01 calls for CB XXX to be pulled in the E&E bay. This is incorrect, the scavenge CB is XXX and was not pulled. The fuel scavenged as normal but crew also had scav pump on EICAS after landing. The MEL is badly written and results in the aircraft thinking it is 1360kg heavier than it actual is. The total res figure on XXX Is also wrong."*

Installation Error

"During preflight checks, we discovered that the ***Transponder panel was fitted upside down.*** We called an engineer to the flight deck which he then promptly corrected it. During flight, we checked the XX and XX and there was no indication of anything that relates to any rectification done on the Transponder. Previous flight of XX was ex XXX which arrived about 10 hours earlier. After the flight, I was informed by XXX that the TV monitor of a XXX passenger, seat 3C, came completely off the metal bracket. It ***appeared to not have any screws*** and that the wire connectors were completely disconnected."

Tooling Error

"Crew change at home base, ***oncoming crew found a Monkey Wrench found in Main Wheel Well.*** *Engineers informed and inspection carried out. No further FOD or any damage found. Wrench shown in location found and also a photo showing where it was found with the wrench removed."*

Procedures Deviation

*"Outstation engineer used a "broom" on both engines, to stop the fan rotation during day stop, instead of using the engine covers, who is present in the aircraft, as described in the normal company procedure for A/C on day stop. When it was brought to my attention, I immediately contacted ..... to get the broom removed from the engines. I told him that his action is totally unacceptable, **"not following the standard procedure,** for mounting engine covers on day stop A/C".*

"We were in the flight deck, engineer entered the E&E bay to replace the flight deck oxygen bottle, this task was done while the aircraft was being refueled, I left the flight deck as he could not contact the fueler from the flight deck to tell him to stop fueling the aircraft because the oxygen bottle was being replaced, I challenged the engineer who said he told the fueler not to fuel the aircraft."

Conclusions

- The overall trend of maintenance errors reporting was fairly constant around 0.065 reports per 1,000 STEADES flights (see Fig. 2).
- The regional variability (see Fig. 3) was consistent with differences in reporting cultures and more analysis should be undertaken regarding its eventual reliance on maintenance operations performance elements.
- The acknowledged dominant source of maintenance error reports (70%) being Flight Crew (see Fig. 5) was a significant limitation in arriving at an accurate allocation of maintenance errors (see Fig. 6). A future revision of the STEADES taxonomy attuned to maintenance occurrence descriptors will enable a more robust analysis.
- **50%** (94) of maintenance errors were classified under the Manual Work (Other than Installation) category.
- Incorrect aircraft configuration (**44%**, 23) was the most frequent UAS due to a maintenance error.
- **83%** (128) of maintenance errors with discovery phase reported were caught either in the hangar before an aircraft release or during walk-around and checklist procedures prior the pushback.
- In **2%** (3) of the reports, the aircraft was unable to fly (AOG) due to a maintenance error.

Recommendations

- To encourage MROs to actively report incidents related to maintenance operations.
- To develop a global dataset for analysis and reporting.
- To develop a global standardized classification system ensuring a more inclusive and accurate capturing of maintenance reported occurrences to enable identification of the top safety issues concerning maintenance operations.
- To encourage airlines to launch safety awareness campaigns among their technical operations (engineering and maintenance) safety staff to improve their safety reporting culture.

Accident Database

From Q1 2013 to Q4 2018, one accident was directly caused by a maintenance error (2017, Air Mandalay, Embraer ERJ145, 0 fatalities). However, deficiencies in maintenance operations, as a latent condition, were involved in 28 accidents (189 fatalities).

Deficiencies in maintenance operations represented 8% of all latent conditions involved in the aircraft accidents. Latent deficiencies in maintenance are the main attributes used in Accident Analysis.

LATENT DEFICIENCIES IN MAINTENANCE OPERATIONS

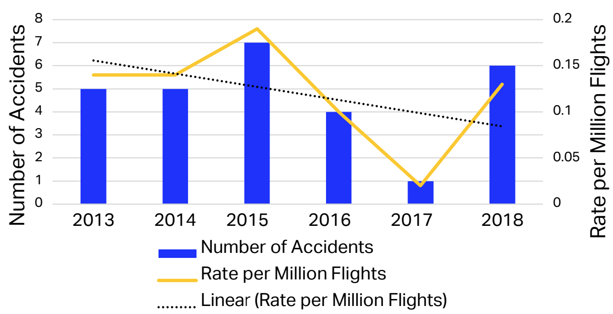


Figure 9: Yearly Distribution

- The number of accidents as well as the accident rate per million flights were the highest in 2015 and the lowest in 2017.
- The overall trend is decreasing.

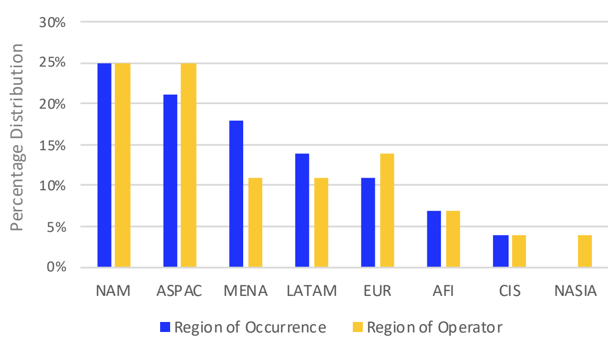


Figure 10: Region of Occurrence and Region of Operator

- **NAM** and **ASPAC** regions had the highest percentage distribution (25%) of accidents as a region of occurrence and a region of operator.

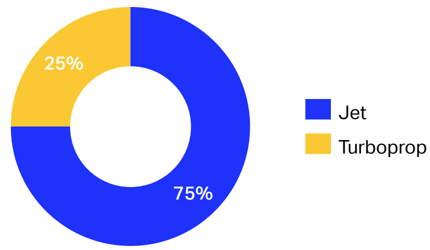


Figure 11: Propulsion Distribution

- **75%** (21) of latent maintenance deficiencies took place on jet aircraft.
- The rest, **25%** (7), were represented by turboprop.

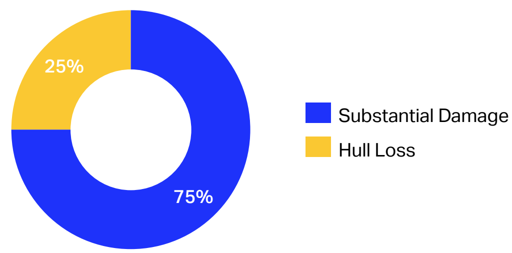


Figure 12: Severity Distribution

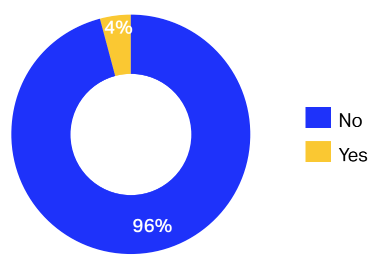


Figure 13: Fatality Distribution

- **Substantial damage** was the prevailing severity in **21** accidents (75%).
- **Hull loss** happened in 7 (25%) of accidents where maintenance operations was a latent deficiency.
- 1 (4%) fatal accident with a latent maintenance deficiency had **189 fatalities** (2018, Lion Air, B737-MAX).
- The overall percentage of fatal accidents, including all latent conditions, was **14%**.

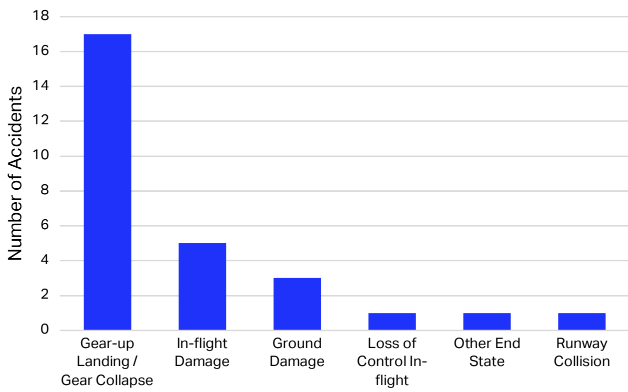


Figure 14: Accident Category

- In **61%** (17) of accidents, where the deficiency of maintenance operations was listed as a latent condition, an aircraft landed with its gear up or the gear collapsed.

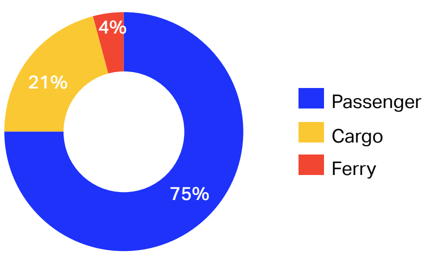


Figure 15: Service Distribution

- The majority of the accidents occurred on passenger flights (75%, 21) followed by cargo flights (21%, 6) and ferry flights (4%, 1).

- **50%** (14) of accidents, where maintenance deficiency was coded as a latent condition, took place during the landing phase.

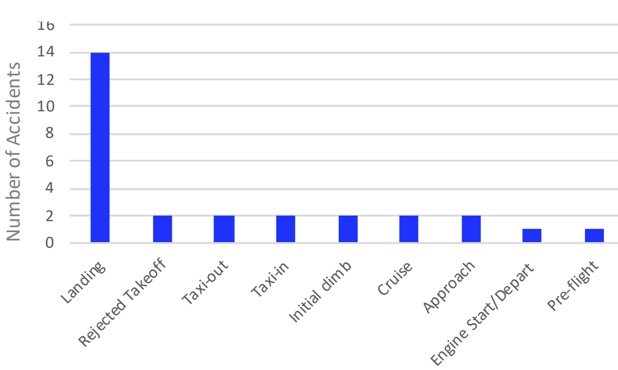


Figure 16: Flight Phase Distribution

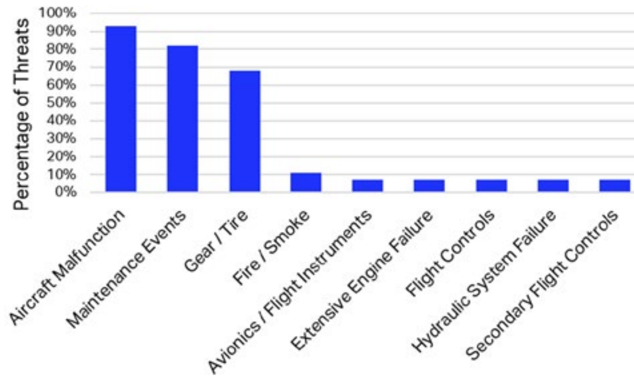


Figure 17: Threat Distribution

- In **82%** of accidents with a latent maintenance deficiency, maintenance events were present and evaluated as a threat.

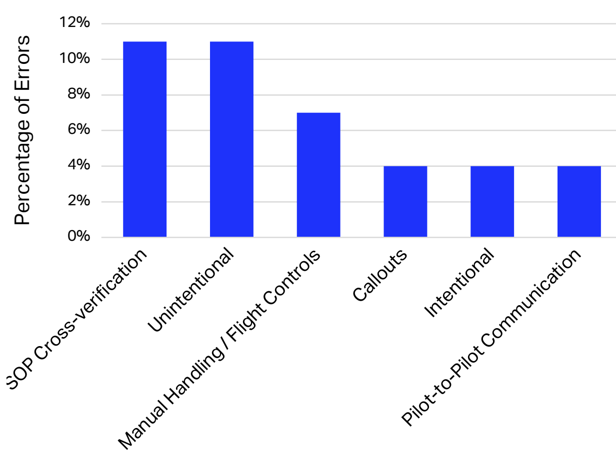


Figure 18: Error Distribution

- An error in SOP Cross-verification was noted in 11% of accidents where a maintenance deficiency was evaluated as a latent condition.

IATA / IOSA Members Distribution

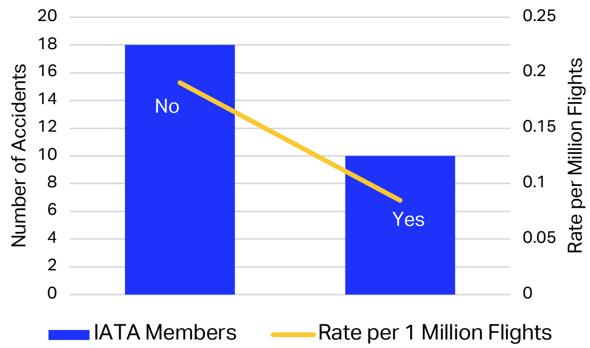


Figure 19: IATA Member Distribution

- Non-IATA members had the higher number of accidents as well as higher rate per million flights.

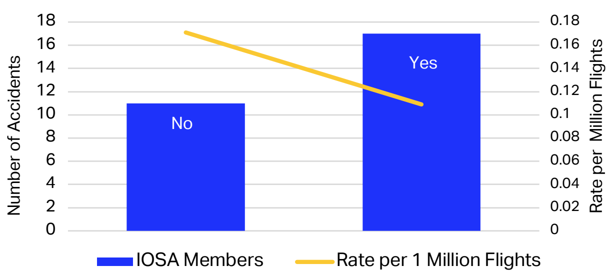


Figure 20: IOSA Member Distribution

- Although there were more accidents for IOSA members, the rate per million flights was lower for IOSA-certified airlines.
- From Q1 2013 to Q4 2018, one accident was directly caused by a maintenance error (2017, Air Mandalay, Embraer ERJ145, 0 fatalities).
- Deficiencies in maintenance operations, as a latent condition, were involved in 28 accidents. This category is used as the main one for accident analysis.
- The number of accidents as well as the accident rate per million flights, with a latent maintenance deficiency, were highest in 2015 and lowest in 2017.
- In **61%** (17) of accidents, where the deficiency of maintenance operations was involved as a latent condition, an aircraft landed with its gear up or the gear collapsed.
- Substantial damage was the prevailing severity in 21 accidents (**75%**).

From Incident to Accident

- While the trend of incident maintenance errors is constant, the trend of maintenance deficiency as a latent condition for accidents is decreasing.
- This suggests that the detection of maintenance errors might have improved so that its consequence could have been held at the incident level.
- This statement may be supported by the fact that **83%** (128) of the maintenance errors were caught either in the hangar before the aircraft release or during walk-around and checklist procedures before pushback. Therefore, a potential countermeasure could have been provided before any aircraft movement.

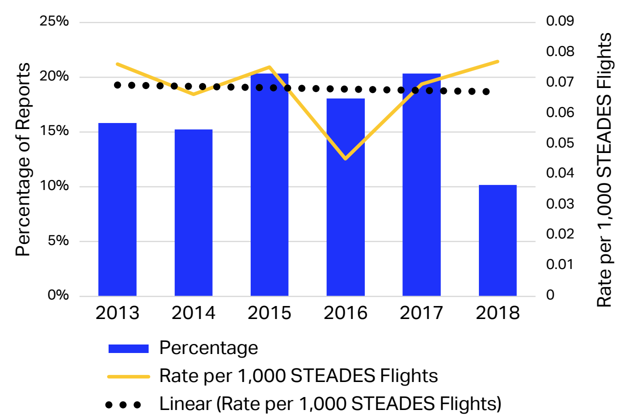


Figure 21: Yearly Distribution - Incidents

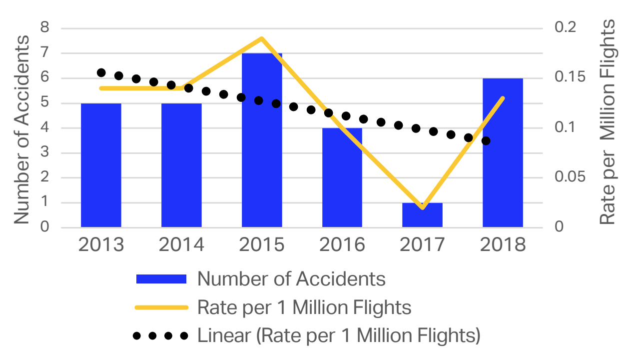


Figure 22: Yearly Distribution – Accidents

Global Safety Information Exchange Harmonized Accident Rate

In the spirit of promoting aviation safety, the Department of Transportation of the United States, the Commission of the European Union, IATA and the ICAO signed a MoU on a Global Safety Information Exchange (GSIE) on 28 September 2010 during the 37th Session of the ICAO Assembly. The objective of the GSIE is to identify information that can be exchanged between the parties to enhance risk reduction activities in the area of aviation safety.

The GSIE developed a harmonized accident rate at the beginning of 2011. This was accomplished through close cooperation between ICAO and IATA to align accident definitions, criteria and analysis methods used to calculate the harmonized rate, which is considered a key safety indicator for commercial aviation operations worldwide. The joint analysis includes accidents following the ICAO Annex 13 criteria for all typical commercial airline operations for scheduled and non-scheduled flights. These accidents were reviewed and validated by the ICAO Safety Indicators Study Group (SISG).

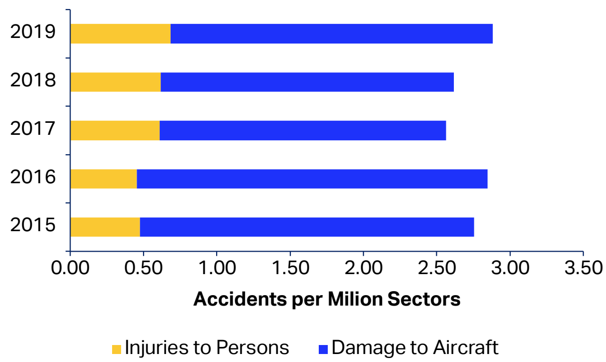
Starting in 2013, ICAO and IATA have increasingly harmonized the accident analysis process and have developed a common list of accident categories to facilitate the sharing and integration of safety data between the two organizations.

Image courtesy of Boeing

Harmonized Analysis of Accidents

A total of 135 accidents were considered as part of the harmonized accident criteria in 2019. These comprise scheduled and non-scheduled commercial operations, including ferry flights for aircraft with a Maximum Takeoff Weight (MTOW) above 5,700 kg. The GSIE harmonized accident rate for the period from 2015 to 2019 is shown below. Since 2013, the accident rate has been broken down by operational safety component: accidents involving damage to aircraft with little or no injury to persons and accidents with serious or fatal injuries to persons.

GSIE Harmonized Accident Rate (accidents per million sectors)



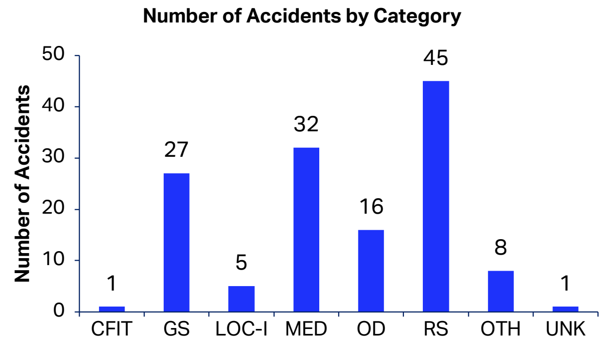
Definitions and Methods

To build upon the harmonized accident rate presented in the last five safety reports, ICAO and IATA worked closely to develop a common taxonomy that would allow for a seamless integration of accident data between the two organizations. A detailed explanation of the harmonized accident categories and how they relate to the Commercial Aviation Safety Team/ICAO Common Taxonomy Team (CICTT) occurrence categories can be found in Table 1 on the next page.

Accidents by Category

Differences between the approaches of the ICAO (CICTT Occurrence Categories) and IATA (flight-crew-centric TEM model) classification systems required the harmonization of the accident criteria to be used. The breakdown of accidents by harmonized category is shown below. Full details of categories can be found in Table 2 on the next page.

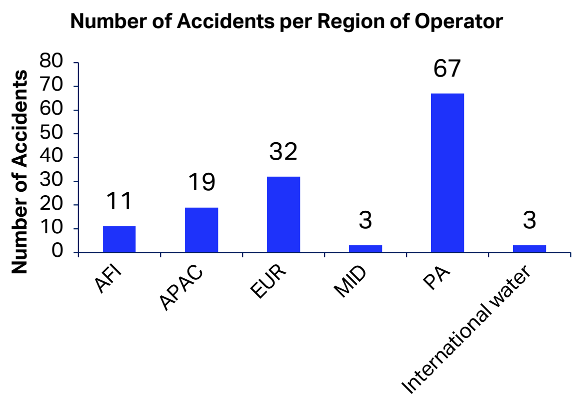
Accidents by Category

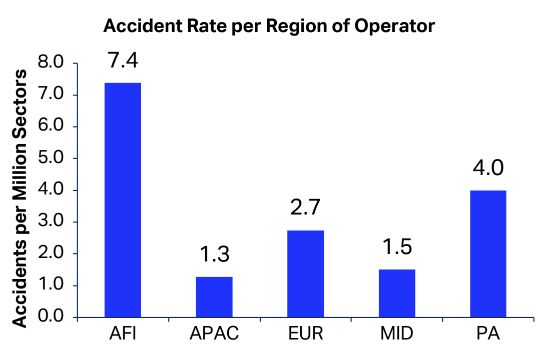


Note: IATA ACTG classified only four accidents as LOC-I; the fifth one could not be assigned an End State due to insufficient data. ICAO SISG categorized two LOC-I accidents as being icing-related occurrences (ICE) and System/Component Failure or Malfunction – Non-Power Plant (SCF-NP). IATA ACTG did not categorize any CFIT accidents in 2019. The one CFIT accident that was assigned by ICAO SISG was categorized as Other End State by IATA ACTG.

Accidents by Region of Occurrence

A harmonized regional analysis is provided by the ICAO Regional Aviation Safety Group (RASG) regions of occurrence. The number of accidents and harmonized accident rate by region are shown in the charts below.





Future Development

Both ICAO and IATA continue to work closely together and, through their respective expert groups, provide greater alignment in their analysis methods and metrics for the future. This ongoing work will be shared with GSIE participants, States, international organizations and safety stakeholders in the interest of promoting harmonized safety reporting at the global level.

GSIE HARMONIZED ACCIDENT CATEGORIES

Table 1

Category	Description
Controlled Flight into Terrain (CFIT)	Includes all instances where the aircraft was flown into terrain in a controlled manner, regardless of the crew's situational awareness. Does not include undershoots, overshoots, or collisions with obstacles on takeoff and landing, which are included in Runway Safety
Loss of Control – In-flight (LOC-I)	Loss of control in-flight that is not recoverable.
Runway Safety (RS)	Includes runway excursions and incursions, as well as undershoot/overshoot, tail strike, hard landing and bird events.
Ground Safety (GS)	Includes ramp safety, ground collisions as well as all ground servicing, preflight, engine start/ departure and arrival events. Taxi and towing events are also included.
Operational Damage (OD)	Damage sustained by the aircraft while operating under its own power. This includes in-flight damage, foreign object debris (FOD) and all system or component failures.
Injuries to and/or Incapacitation of Persons (MED)	All injuries or incapacitations sustained by anyone coming into direct contact with any part of the aircraft structure. Includes turbulence-related injuries, injuries to ground staff coming into contact with the structure, engines or control surfaces of the aircraft and on-board injuries or incapacitations and fatalities not related to unlawful external interference.
Other (OTH)	Any event that does not fit into the categories listed above.
Unknown (UNK)	Any event where the exact cause cannot be reasonably determined through information or inference, or when there are insufficient facts to make a conclusive decision regarding classification.

Table 2

Category	CICTT* Occurrence Categories	IATA Classification End States
Controlled Flight into Terrain (CFIT)	CFIT, CTOL	CFIT
Loss of Control – In-flight (LOC-I)	LOC-I	LOC-I
Runway Safety (RS)	RE, RI, ARC, USOS, BIRD	Runway Excursion, Runway Collision, Tail Strike, Hard Landing, Undershoot, Gear-up Landing / Gear Collapse
Ground Safety (GS)	G-COL, RAMP, LOC-G	Ground Damage
Operational Damage (OD)	SCF-NP, SCF-PP	In-flight Damage
Injuries to and/or Incapacitation of Persons (MED)	CABIN, MED, TURB	None (excluded from IATA Safety Report)
Other (OTH)	All other CICTT Occurrence Categories	All other IATA End States
Unknown (UNK)	UNK	Insufficient Data

* CAST/ICAO Common Taxonomy Team

Addendum A

Primary Contributing Factors – Section 4

2019 Aircraft Accidents

LATENT CONDITIONS

	Percentage Contribution
Safety Management	32%
Regulatory Oversight	28%
Flight Operations	17%
Maintenance Ops: SOPs & Checking	13%
Maintenance Operations	13%
Flight Ops: Training Systems	11%
Selection Systems	9%
Flight Ops: SOPs & Checking	6%
Design	4%
Management Decisions	4%
Ground Ops: SOPs & Checking	4%
Ops Planning & Scheduling	4%
Ground Operations	4%
Change Management	2%
Technology & Equipment	2%
Cabin Operations	2%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	45%
SOP Adherence/SOP Cross-verification	26%
Failure to GOA after abnormal runway contact	15%
Abnormal Checklist	9%
Crew to External Communication	2%
Automation	2%
ATC	2%
Normal Checklist	2%
Callouts	2%
Pilot-to-Pilot Communication	2%
Systems/Radios/Instruments	2%

2019 Aircraft Accidents

THREATS

	Percentage Contribution
Meteorology	43%
Wind/Wind shear/Gusty wind	28%
Thunderstorms	26%
Airport Facilities	23%
Aircraft Malfunction	21%
Poor visibility/IMC	17%
Contaminated runway/taxiway - poor braking action	13%
Wildlife/Birds/Foreign Object	11%
Gear/Tire	11%
Operational Pressure	9%
Icing Conditions	6%
Ground Events	6%
Inad overrun area/trench/ditch/prox of structures	6%
Terrain/Obstacles	6%
Nav Aids	4%
Ground-based nav aid malfunction or not available	4%
Airport perimeter control/fencing/wildlife control	4%
Maintenance Events	4%
Contained Engine Failure/Powerplant Malfunction	4%
Fire / Smoke (Cockpit / Cabin / Cargo)	2%
Optical illusion /visual misperception	2%
MEL Item	2%
Hydraulic System Failure	2%
Traffic	2%
Electrical Power Generation Failure	2%

2019 Aircraft Accidents

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Long/floated/bounced/firm/off-center/crabbed land	30%
Vertical/Lateral/Speed Deviation	26%
Abrupt Aircraft Control	23%
Unnecessary Weather Penetration	21%
Continued Landing after Unstable Approach	13%
Unstable Approach	11%
Operation Outside Aircraft Limitations	11%
Flight Controls/Automation	6%
Brakes/Thrust Reversers/Ground Spoilers	6%
Loss of aircraft control while on the ground	2%
Systems	2%

COUNTERMEASURES

	Percentage Contribution
Monitor/Cross-check	21%
In-flight decision-making/contingency management	21%
Overall Crew Performance	19%
Captain should show leadership	17%
Leadership	17%
Taxiway/Runway Management	11%
Automation Management	9%
Workload Management	9%
Evaluation of Plans	6%
Communication Environment	4%
FO is assertive when necessary	2%
SOP Briefing/Planning	2%

Note: five accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum A

Top Contributing Factors – Section 4

2015-2019 Aircraft Accidents

LATENT CONDITIONS

	Percentage Contribution
Regulatory Oversight	32%
Safety Management	31%
Flight Operations	22%
Flight Ops: SOPs & Checking	15%
Flight Ops: Training Systems	14%
Maintenance Operations	11%
Selection Systems	10%
Maintenance Ops: SOPs & Checking	10%
Design	7%
Management Decisions	7%
Ground Operations	4%
Technology & Equipment	3%
Ground Ops: SOPs & Checking	3%
Dispatch	3%
Ops Planning & Scheduling	2%
Ground Ops: Training Systems	2%
Dispatch Ops: SOPs & Checking	2%
Change Management	2%
Maintenance Ops: Training Systems	1%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	39%
SOP Adherence/SOP Cross-verification	32%
Callouts	11%
Pilot-to-Pilot Communication	10%
Failure to GOA after abnormal runway contact	6%
Abnormal Checklist	5%
Automation	4%
Crew to External Communication	3%
Ground Navigation	2%
Normal Checklist	2%
Systems/Radios/Instruments	2%
Briefings	2%
ATC	2%
Wrong Weight & Balance/Fuel Information	2%
Documentation	2%

2015-2019 Aircraft Accidents

THREATS

	Percentage Contribution
Meteorology	36%
Aircraft Malfunction	29%
Wind/Wind shear/Gusty wind	21%
Airport Facilities	19%
Thunderstorms	14%
Gear/Tire	13%
Poor visibility/IMC	13%
Maintenance Events	13%
Contaminated runway/taxiway - poor braking action	9%
Operational Pressure	9%
Lack of visual reference	7%
Ground Events	7%
Nav Aids	6%
Ground-based nav aid malfunction or not available	6%
Fatigue	5%
Wildlife/Birds/Foreign Object	5%
Air Traffic Services	5%
Fire/Smoke (Cockpit/Cabin/Cargo)	5%
Poor/faint marking/signs or runway/taxiway closure	4%
Inad overrun area/trench/ditch/prox of structures	4%
Optical Illusion/visual misperception	4%
Contained Engine Failure/Powerplant Malfunction	3%
Dispatch/Paperwork	3%
Traffic	3%
Icing Conditions	3%
Airport perimeter control/fencing/wildlife control	3%
Extensive/Uncontained Engine Failure	3%
Terrain/Obstacles	2%
MEL Item	2%
Avionics/Flight Instruments	1%
Spatial Disorientation/somatogravic illusion	1%
Hydraulic System Failure	1%
Manuals/Charts/Checklists	1%
Crew Incapacitation	1%
Brakes	1%

2015-2019 Aircraft Accidents

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Long/floated/bounced/firm/off-center/crabbed landing	24%
Vertical/Lateral/Speed Deviation	23%
Unstable Approach	17%
Abrupt Aircraft Control	14%
Unnecessary Weather Penetration	14%
Continued Landing after Unstable Approach	13%
Operation Outside Aircraft Limitations	9%
Brakes/Thrust Reversers/Ground Spoilers	5%
Engine	5%
Flight Controls/Automation	3%
Loss of aircraft control while on the ground	3%
Controlled Flight Toward Terrain	3%
Ramp movements	2%
Rejected Takeoff after V_1	2%
Weight & Balance	1%
Systems	1%
Runway/taxiway incursion	1%
Unauthorized Airspace Penetration	1%
Landing Gear	1%

COUNTERMEASURES

	Percentage Contribution
Overall Crew Performance	27%
Monitor/Cross-check	20%
In-flight decision-making/contingency management	14%
Leadership	13%
Captain should show leadership	12%
Taxiway/Runway Management	8%
FO is assertive when necessary	7%
Workload Management	7%
Automation Management	5%
Communication Environment	5%
Evaluation of Plans	4%
Inquiry	1%

Note: 28 accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum A

Top Contributing Factors – Section 4

2015-2019 Fatal Aircraft Accidents

LATENT CONDITIONS

	Percentage Contribution
Safety Management	61%
Regulatory Oversight	55%
Flight Operations	48%
Flight Ops: SOPs & Checking	35%
Flight Ops: Training Systems	32%
Selection Systems	29%
Management Decisions	23%
Dispatch Ops: SOPs & Checking	13%
Dispatch	13%
Maintenance Operations	10%
Ops Planning & Scheduling	10%
Change Management	10%
Design	10%
Maintenance Ops: SOPs & Checking	10%
Technology & Equipment	6%
Ground Ops: SOPs & Checking	6%
Ground Operations	6%
Maintenance Ops: Training Systems	3%
Ground Ops: Training Systems	3%

FLIGHT CREW ERRORS

	Percentage Contribution
SOP Adherence/SOP Cross-verification	58%
Manual Handling/Flight Controls	48%
Pilot-to-Pilot Communication	32%
Callouts	26%
Abnormal Checklist	19%
Systems/Radios/Instruments	10%
ATC	6%
Briefings	6%
Documentation	6%
Crew to External Communication	6%
Wrong Weight & Balance/Fuel Information	6%
Failure to GOA after abnormal runway contact	3%
Automation	3%
Normal Checklist	3%
Dispatch	3%

2015-2019 Fatal Aircraft Accidents

THREATS

	Percentage Contribution
Meteorology	48%
Aircraft Malfunction	35%
Operational Pressure	29%
Poor visibility/IMC	26%
Fatigue	23%
Lack of visual reference	19%
Wind/Wind shear/Gusty wind	16%
Contained Engine Failure/Powerplant Malfunction	16%
Air Traffic Services	13%
Dispatch/Paperwork	13%
Thunderstorms	13%
Terrain/Obstacles	10%
Ground-based nav aid malfunction or not available	10%
Icing Conditions	10%
Nav Aids	10%
Maintenance Events	10%
Spatial Disorientation/somatogravic illusion	10%
Airport Facilities	6%
Inad overrun area/trench/ditch/prox of structures	6%
Avionics/Flight Instruments	6%
Ground Events	6%
Extensive/Uncontained Engine Failure	3%
Wildlife/Birds/Foreign Object	3%
Hydraulic System Failure	3%
Crew Incapacitation	3%
Structural Failure	3%
MEL Item	3%
Manuals/Charts/Checklists	3%

2015-2019 Fatal Aircraft Accidents

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Vertical/Lateral/Speed Deviation	42%
Operation Outside Aircraft Limitations	39%
Abrupt Aircraft Control	32%
Unnecessary Weather Penetration	26%
Controlled Flight Toward Terrain	19%
Continued Landing after Unstable Approach	19%
Unstable Approach	16%
Engine	13%
Flight Controls/Automation	10%
Long/floated/bounced/firm/off-center/crabbed landing	10%
Brakes/Thrust Reversers/Ground Spoilers	6%
Weight & Balance	6%
Loss of aircraft control while on the ground	3%
Unauthorized Airspace Penetration	3%
Systems	3%

COUNTERMEASURES

	Percentage Contribution
Monitor/Cross-check	52%
Overall Crew Performance	48%
Leadership	42%
Captain should show leadership	42%
In-flight decision-making/contingency management	39%
FO is assertive when necessary	26%
Communication Environment	26%
Workload Management	16%
Automation Management	16%
Evaluation of Plans	13%
Taxiway/Runway Management	10%
Plans Stated	3%
Inquiry	3%
SOP Briefing/Planning	3%

Note: three accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum A

Top Contributing Factors – Section 4

2015-2019 Nonfatal Aircraft Accidents

LATENT CONDITIONS

	Percentage Contribution
Regulatory Oversight	29%
Safety Management	27%
Flight Operations	19%
Flight Ops: SOPs & Checking	12%
Flight Ops: Training Systems	11%
Maintenance Operations	11%
Maintenance Ops: SOPs & Checking	10%
Selection Systems	8%
Design	6%
Management Decisions	4%
Ground Operations	3%
Technology & Equipment	3%
Ground Ops: SOPs & Checking	3%
Ground Ops: Training Systems	2%
Ops Planning & Scheduling	1%
Dispatch	1%
Change Management	1%
Maintenance Ops: Training Systems	1%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	38%
SOP Adherence/SOP Cross-verification	28%
Callouts	9%
Pilot-to-Pilot Communication	7%
Failure to GOA after abnormal runway contact	7%
Automation	4%
Abnormal Checklist	3%
Ground Navigation	3%
Normal Checklist	2%
Crew to External Communication	2%
Briefings	1%
Systems/Radios/Instruments	1%
ATC	1%
Wrong Weight & Balance/Fuel Information	1%
Documentation	1%

2015-2019 Nonfatal Aircraft Accidents

THREATS

	Percentage Contribution
Meteorology	34%
Aircraft Malfunction	28%
Wind/Wind shear/Gusty wind	22%
Airport Facilities	21%
Gear/Tire	15%
Thunderstorms	14%
Maintenance Events	14%
Poor visibility/IMC	11%
Contaminated runway/taxiway - poor braking action	10%
Ground Events	7%
Operational Pressure	7%
Ground-based nav aid malfunction or not available	6%
Nav Aids	6%
Lack of visual reference	5%
Fire/Smoke (Cockpit/Cabin/Cargo)	5%
Wildlife/Birds/Foreign Object	5%
Poor/faint marking/signs or runway/taxiway closure	5%
Optical Illusion/visual misperception	4%
Inad overrun area/trench/ditch/prox of structures	4%
Air Traffic Services	4%
Traffic	4%
Fatigue	3%
Airport perimeter control/fencing/wildlife control	3%
Extensive/Uncontained Engine Failure	3%
Dispatch/Paperwork	2%
Icing Conditions	2%
Contained Engine Failure/Powerplant Malfunction	2%
MEL Item	1%
Brakes	1%
Crew Incapacitation	1%
Hydraulic System Failure	1%
Manuals/Charts/Checklists	1%
Terrain/Obstacles	1%

2015-2019 Nonfatal Aircraft Accidents

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Long/floated/bounced/firm/off-center/crabbed landing	26%
Vertical/Lateral/Speed Deviation	20%
Unstable Approach	17%
Continued Landing after Unstable Approach	13%
Unnecessary Weather Penetration	12%
Abrupt Aircraft Control	11%
Brakes/Thrust Reversers/Ground Spoilers	5%
Operation Outside Aircraft Limitations	5%
Loss of aircraft control while on the ground	3%
Engine	3%
Ramp movements	3%
Flight Controls/Automation	3%
Rejected Takeoff after V_1	2%
Runway/taxiway incursion	1%
Landing Gear	1%
Controlled Flight Toward Terrain	1%

COUNTERMEASURES

	Percentage Contribution
Overall Crew Performance	24%
Monitor/Cross-check	16%
In-flight decision-making/contingency management	10%
Leadership	10%
Captain should show leadership	8%
Taxiway/Runway Management	8%
Workload Management	5%
FO is assertive when necessary	4%
Automation Management	4%
Evaluation of Plans	3%
Communication Environment	2%

Note: 25 accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum A

Top Contributing Factors – Section 4

2015-2019 IOSA Aircraft Accidents

LATENT CONDITIONS

	Percentage Contribution
Regulatory Oversight	26%
Safety Management	23%
Flight Operations	20%
Flight Ops: Training Systems	14%
Flight Ops: SOPs & Checking	14%
Maintenance Operations	11%
Maintenance Ops: SOPs & Checking	10%
Selection Systems	9%
Design	8%
Management Decisions	4%
Technology & Equipment	4%
Change Management	4%
Ground Operations	4%
Ops Planning & Scheduling	2%
Ground Ops: SOPs & Checking	2%
Ground Ops: Training Systems	2%
Maintenance Ops: Training Systems	1%
Cabin Operations	1%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	39%
SOP Adherence/SOP Cross-verification	29%
Pilot-to-Pilot Communication	12%
Callouts	11%
Failure to GOA after abnormal runway contact	7%
Automation	5%
Abnormal Checklist	5%
Ground Navigation	4%
Systems/Radios/Instruments	3%
Normal Checklist	2%
Crew to External Communication	1%
Ground Crew	1%
ATC	1%
Briefings	1%
Wrong Weight & Balance/Fuel Information	1%
Documentation	1%

2015-2019 IOSA Aircraft Accidents

THREATS

	Percentage Contribution
Meteorology	34%
Aircraft Malfunction	28%
Wind/Wind shear/Gusty wind	22%
Gear/Tire	15%
Airport Facilities	15%
Thunderstorms	14%
Maintenance Events	14%
Poor visibility/IMC	14%
Contaminated runway/taxiway - poor braking action	9%
Ground Events	9%
Lack of visual reference	7%
Fire/Smoke (Cockpit/Cabin/Cargo)	7%
Operational Pressure	7%
Fatigue	6%
Traffic	5%
Wildlife/Birds/Foreign Object	5%
Air Traffic Services	4%
Optical Illusion/visual misperception	4%
Nav Aids	4%
Ground-based nav aid malfunction or not available	4%
Poor/faint marking/signs or runway/taxiway closure	3%
Extensive/Uncontained Engine Failure	3%
Inad overrun area/trench/ditch/prox of structures	3%
Contained Engine Failure/Powerplant Malfunction	2%
Manuals/Charts/Checklists	2%
Dispatch/Paperwork	2%
Hydraulic System Failure	1%
Airport perimeter control/fencing/wildlife control	1%
Spatial Disorientation/somatogravic illusion	1%
Icing Conditions	1%
Terrain/Obstacles	1%
MEL Item	1%
Avionics/Flight Instruments	1%
Electrical Power Generation Failure	1%
Brakes	1%

2015-2019 IOSA Aircraft Accidents

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Vertical/Lateral/Speed Deviation	28%
Long/floated/bounced/firm/off-center/crabbed landing	23%
Abrupt Aircraft Control	16%
Unstable Approach	16%
Continued Landing after Unstable Approach	14%
Unnecessary Weather Penetration	13%
Brakes/Thrust Reversers/Ground Spoilers	6%
Flight Controls/Automation	5%
Engine	5%
Operation Outside Aircraft Limitations	4%
Ramp movements	4%
Controlled Flight Toward Terrain	4%
Loss of aircraft control while on the ground	4%
Systems	1%
Runway/taxiway incursion	1%
Wrong taxiway/ramp/gate/hold spot	1%
Rejected Takeoff after V_1	1%

COUNTERMEASURES

	Percentage Contribution
Overall Crew Performance	26%
Monitor/Cross-check	20%
Leadership	16%
Captain should show leadership	15%
In-flight decision-making/contingency management	13%
Workload Management	7%
Communication Environment	7%
FO is assertive when necessary	7%
Automation Management	7%
Taxiway/Runway Management	6%
Evaluation of Plans	1%

Note: 9 accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Top Contributing Factors – Section 4

2015-2019 Non-IOSA Aircraft Accidents

LATENT CONDITIONS

	Percentage Contribution
Regulatory Oversight	39%
Safety Management	39%
Flight Operations	24%
Flight Ops: SOPs & Checking	15%
Flight Ops: Training Systems	14%
Selection Systems	11%
Maintenance Operations	11%
Maintenance Ops: SOPs & Checking	10%
Management Decisions	9%
Dispatch	6%
Design	5%
Ground Operations	4%
Dispatch Ops: SOPs & Checking	4%
Ground Ops: SOPs & Checking	4%
Technology & Equipment	3%
Ops Planning & Scheduling	2%
Ground Ops: Training Systems	2%
Maintenance Ops: Training Systems	1%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	39%
SOP Adherence/SOP Cross-verification	34%
Callouts	11%
Pilot-to-Pilot Communication	7%
Failure to GOA after abnormal runway contact	5%
Abnormal Checklist	4%
Crew to External Communication	4%
Briefings	3%
ATC	3%
Automation	2%
Wrong Weight & Balance/Fuel Information	2%
Documentation	2%
Normal Checklist	2%
Systems/Radios/Instruments	2%
Dispatch	1%
Maintenance	1%
Ground Navigation	1%

2015-2019 Non-IOSA Aircraft Accidents

THREATS

	Percentage Contribution
Meteorology	37%
Aircraft Malfunction	29%
Airport Facilities	23%
Wind/Wind shear/Gusty wind	20%
Thunderstorms	14%
Maintenance Events	12%
Operational Pressure	12%
Poor visibility/IMC	12%
Gear/Tire	11%
Contaminated runway/taxiway - poor braking action	10%
Nav Aids	9%
Ground-based nav aid malfunction or not available	9%
Lack of visual reference	7%
Inad overrun area/trench/ditch/prox of structures	6%
Poor/faint marking/signs or runway/taxiway closure	6%
Contained Engine Failure/Powerplant Malfunction	5%
Air Traffic Services	5%
Icing Conditions	5%
Fatigue	5%
Dispatch/Paperwork	5%
Wildlife/Birds/Foreign Object	5%
Airport perimeter control/fencing/wildlife control	4%
Ground Events	4%
Optical Illusion/visual misperception	3%
MEL Item	2%
Crew Incapacitation	2%
Fire/Smoke (Cockpit/Cabin/Cargo)	2%
Extensive/Uncontained Engine Failure	2%
Terrain/Obstacles	2%
Avionics/Flight Instruments	2%
Brakes	2%
Structural Failure	1%
Hydraulic System Failure	1%
Spatial Disorientation/somatogravic illusion	1%
Flight Controls	1%
Primary Flight Controls	1%
Traffic	1%

2015-2019 Non-IOSA Aircraft Accidents

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Long/floated/bounced/firm/off-center/crabbed landing	24%
Unstable Approach	17%
Vertical/Lateral/Speed Deviation	16%
Operation Outside Aircraft Limitations	15%
Unnecessary Weather Penetration	15%
Continued Landing after Unstable Approach	13%
Abrupt Aircraft Control	11%
Brakes/Thrust Reversers/Ground Spoilers	5%
Engine	4%
Loss of aircraft control while on the ground	3%
Rejected Takeoff after V_1	2%
Controlled Flight Toward Terrain	2%
Weight & Balance	2%
Landing Gear	2%
Unauthorized Airspace Penetration	2%
Flight Controls/Automation	2%
Runway/taxiway incursion	1%
Systems	1%

COUNTERMEASURES

	Percentage Contribution
Overall Crew Performance	28%
Monitor/Cross-check	21%
In-flight decision-making/contingency management	15%
Leadership	11%
Taxiway/Runway Management	11%
Captain should show leadership	9%
FO is assertive when necessary	7%
Evaluation of Plans	7%
Workload Management	6%
Automation Management	3%
Communication Environment	2%
Inquiry	2%
SOP Briefing/Planning	1%
Plans Stated	1%

Note: 19 accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum A

Top Contributing Factors – Section 4

Controlled Flight into Terrain

LATENT CONDITIONS

	Percentage Contribution
Regulatory Oversight	100%
Flight Operations	75%
Flight Ops: SOPs & Checking	75%
Safety Management	75%
Technology & Equipment	50%
Selection Systems	50%
Flight Ops: Training Systems	25%
Management Decisions	25%

THREATS

	Percentage Contribution
Meteorology	75%
Lack of visual reference	75%
Poor visibility/IMC	75%
Nav Aids	50%
Operational Pressure	50%
Ground-based nav aid malfunction or not available	50%
Fatigue	50%
Airport Facilities	25%
Manuals/Charts/Checklists	25%
Air Traffic Services	25%
Wind/Wind shear/Gusty wind	25%
Terrain/Obstacles	25%
Dispatch/Paperwork	25%
Poor/faint marking/signs or runway/taxiway closure	25%

Controlled Flight into Terrain

FLIGHT CREW ERRORS

	Percentage Contribution
SOP Adherence/SOP Cross-verification	100%
Callouts	50%
Briefings	25%
Manual Handling/Flight Controls	25%

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Unnecessary Weather Penetration	50%
Vertical/Lateral/Speed Deviation	50%
Abrupt Aircraft Control	25%
Continued Landing after Unstable Approach	25%
Unstable Approach	25%
Operation Outside Aircraft Limitations	25%
Engine	25%

COUNTERMEASURES

	Percentage Contribution
Overall Crew Performance	75%
Monitor/Cross-check	75%
In-flight decision-making/contingency management	75%
Leadership	50%
Captain should show leadership	50%
FO is assertive when necessary	50%
Communication Environment	25%
Automation Management	25%

Note: all of the accidents were classified.

Addendum A

Top Contributing Factors – Section 4

Loss of Control – In-flight

LATENT CONDITIONS

	Percentage Contribution
Flight Operations	55%
Safety Management	50%
Regulatory Oversight	40%
Flight Ops: SOPs & Checking	40%
Flight Ops: Training Systems	40%
Selection Systems	35%
Management Decisions	20%
Change Management	15%
Dispatch	15%
Dispatch Ops: SOPs & Checking	15%
Ground Ops: SOPs & Checking	10%
Ops Planning & Scheduling	10%
Ground Operations	10%
Design	10%
Maintenance Operations	5%
Maintenance Ops: SOPs & Checking	5%
Ground Ops: Training Systems	5%
Maintenance Ops: Training Systems	5%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	50%
SOP Adherence/SOP Cross-verification	50%
Pilot-to-Pilot Communication	35%
Abnormal Checklist	25%
Callouts	20%
Systems/Radios/Instruments	15%
Automation	10%
Wrong Weight & Balance/Fuel Information	5%
Normal Checklist	5%
Documentation	5%

Loss of Control – In-flight

THREATS

	Percentage Contribution
Meteorology	45%
Aircraft Malfunction	35%
Poor visibility/IMC	20%
Contained Engine Failure/Powerplant Malfunction	20%
Icing Conditions	15%
Wind/Wind shear/Gusty wind	15%
Fatigue	15%
Spatial Disorientation/somatogravic illusion	15%
Lack of visual reference	15%
Operational Pressure	15%
Ground Events	10%
Maintenance Events	10%
Avionics/Flight Instruments	10%
Dispatch/Paperwork	10%
Thunderstorms	5%
Wildlife/Birds/Foreign Object	5%
Air Traffic Services	5%
Inad overrun area/trench/ditch/prox of structures	5%
Manuals/Charts/Checklists	5%
MEL Item	5%
Airport Facilities	5%

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Operation Outside Aircraft Limitations	40%
Vertical/Lateral/Speed Deviation	35%
Abrupt Aircraft Control	30%
Flight Controls/Automation	20%
Unnecessary Weather Penetration	15%
Weight & Balance	10%
Engine	10%
Unstable Approach	5%
Continued Landing after Unstable Approach	5%
Long/floated/bounced/firm/off-center/crabbed landing	5%
Systems	5%

COUNTERMEASURES

	Percentage Contribution
Overall Crew Performance	50%
Monitor/Cross-check	50%
Leadership	40%
Captain should show leadership	40%
In-flight decision-making/contingency management	30%
Workload Management	20%
FO is assertive when necessary	20%
Communication Environment	20%
Automation Management	15%
Taxiway/Runway Management	5%
SOP Briefing/Planning	5%
Evaluation of Plans	5%

Note: three accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum A

Top Contributing Factors – Section 4

Mid-Air Collision

At least three accidents are required before the accident classification is provided.
This category only contained one accident in the past five years.

Addendum A

Top Contributing Factors – Section 4

Runway/Taxiway Excursion

LATENT CONDITIONS

	Percentage Contribution
Safety Management	41%
Regulatory Oversight	40%
Flight Operations	22%
Flight Ops: Training Systems	16%
Flight Ops: SOPs & Checking	13%
Selection Systems	10%
Maintenance Operations	8%
Maintenance Ops: SOPs & Checking	8%
Technology & Equipment	5%
Design	3%
Change Management	3%
Ops Planning & Scheduling	2%
Management Decisions	2%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	48%
SOP Adherence/SOP Cross-verification	37%
Callouts	17%
Pilot-to-Pilot Communication	10%
Failure to GOA after abnormal runway contact	8%
Automation	6%
Normal Checklist	5%
Abnormal Checklist	3%
Briefings	3%
ATC	3%
Crew to External Communication	3%
Ground Navigation	2%

Runway/Taxiway Excursion

THREATS

	Percentage Contribution
Meteorology	56%
Airport Facilities	49%
Wind/Wind shear/Gusty wind	35%
Contaminated runway/taxiway - poor braking action	33%
Thunderstorms	27%
Aircraft Malfunction	17%
Poor visibility/IMC	16%
Operational Pressure	13%
Inad overrun area/trench/ditch/prox of structures	11%
Fatigue	8%
Poor/faint marking/signs or runway/taxiway closure	8%
Optical Illusion/visual misperception	6%
Icing Conditions	6%
Maintenance Events	6%
Nav Aids	6%
Ground-based nav aid malfunction or not available	6%
Air Traffic Services	5%
MEL Item	5%
Contained Engine Failure/Powerplant Malfunction	5%
Terrain/Obstacles	3%
Airport perimeter control/fencing/wildlife control	3%
Wildlife/Birds/Foreign Object	3%
Lack of visual reference	3%
Crew Incapacitation	3%
Primary Flight Controls	2%
Brakes	2%
Fire/Smoke (Cockpit/Cabin/Cargo)	2%
Manuals/Charts/Checklists	2%
Hydraulic System Failure	2%
Gear/Tire	2%
Flight Controls	2%

Runway/Taxiway Excursion

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Long/floated/bounced/firm/off-center/crabbed landing	40%
Unstable Approach	22%
Unnecessary Weather Penetration	21%
Continued Landing after Unstable Approach	21%
Vertical/Lateral/Speed Deviation	21%
Brakes/Thrust Reversers/Ground Spoilers	14%
Abrupt Aircraft Control	10%
Operation Outside Aircraft Limitations	10%
Loss of aircraft control while on the ground	8%
Flight Controls/Automation	5%
Engine	5%
Rejected Takeoff after V_1	3%
Unauthorized Airspace Penetration	2%

COUNTERMEASURES

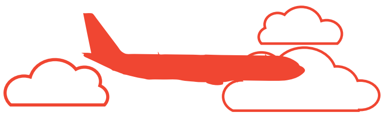
	Percentage Contribution
Overall Crew Performance	37%
Taxiway/Runway Management	27%
Monitor/Cross-check	22%
In-flight decision-making/contingency management	19%
Leadership	16%
Captain should show leadership	13%
Workload Management	10%
FO is assertive when necessary	6%
Evaluation of Plans	5%
Automation Management	5%
Communication Environment	3%

Note: 12 accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum A

Top Contributing Factors – Section 4

In-flight Damage



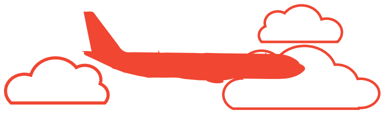
LATENT CONDITIONS

	Percentage Contribution
Regulatory Oversight	16%
Design	13%
Safety Management	13%
Maintenance Operations	11%
Maintenance Ops: SOPs & Checking	11%
Management Decisions	5%
Ground Ops: Training Systems	3%
Flight Ops: SOPs & Checking	3%
Ground Operations	3%
Ground Ops: SOPs & Checking	3%
Flight Operations	3%

THREATS

	Percentage Contribution
Aircraft Malfunction	34%
Maintenance Events	18%
Meteorology	16%
Wildlife/Birds/Foreign Object	16%
Extensive/Uncontained Engine Failure	13%
Thunderstorms	11%
Airport Facilities	11%
Fire/Smoke (Cockpit/Cabin/Cargo)	11%
Airport perimeter control/fencing/wildlife control	8%
Ground Events	5%
Wind/Wind shear/Gusty wind	5%
Gear/Tire	5%
Contained Engine Failure/Powerplant Malfunction	3%
Structural Failure	3%
Brakes	3%
Contaminated runway/taxiway - poor braking action	3%
Dispatch/Paperwork	3%
Poor visibility/IMC	3%

In-flight Damage



FLIGHT CREW ERRORS

	Percentage Contribution
SOP Adherence/SOP Cross-verification	11%
Manual Handling/Flight Controls	5%
Failure to GOA after abnormal runway contact	3%

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Unnecessary Weather Penetration	13%
Abrupt Aircraft Control	5%
Long/floated/bounced/firm/off-center/crabbed landing	3%
Operation Outside Aircraft Limitations	3%
Vertical/Lateral/Speed Deviation	3%

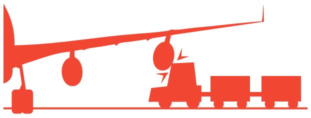
COUNTERMEASURES

	Percentage Contribution
Evaluation of Plans	3%
In-flight decision-making/contingency management	3%

Note: two accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Top Contributing Factors – Section 4

Ground Damage



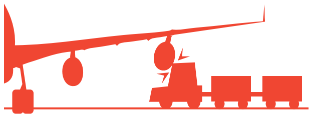
LATENT CONDITIONS

	Percentage Contribution
Ground Ops: SOPs & Checking	22%
Ground Operations	22%
Safety Management	17%
Regulatory Oversight	13%
Ground Ops: Training Systems	9%
Design	9%
Flight Ops: Training Systems	4%
Maintenance Operations	4%
Flight Operations	4%
Flight Ops: SOPs & Checking	4%
Maintenance Ops: SOPs & Checking	4%

THREATS

	Percentage Contribution
Ground Events	30%
Traffic	26%
Aircraft Malfunction	13%
Airport Facilities	9%
Fire/Smoke (Cockpit/Cabin/Cargo)	9%
Meteorology	9%
Maintenance Events	9%
Operational Pressure	9%
Wind/Wind shear/Gusty wind	4%
Poor visibility/IMC	4%
Poor/faint marking/signs or runway/taxiway closure	4%
Brakes	4%
Inad overrun area/trench/ditch/prox of structures	4%

Ground Damage



FLIGHT CREW ERRORS

	Percentage Contribution
Ground Navigation	13%
Manual Handling/Flight Controls	4%
Abnormal Checklist	4%
Callouts	4%

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Ramp movements	17%
Loss of aircraft control while on the ground	9%
Brakes/Thrust Reversers/Ground Spoilers	4%

COUNTERMEASURES

	Percentage Contribution
Overall Crew Performance	13%
Taxiway/Runway Management	9%
Monitor/Cross-check	4%
Leadership	4%
Captain should show leadership	4%

Note: four accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum A

Top Contributing Factors – Section 4

Undershoot

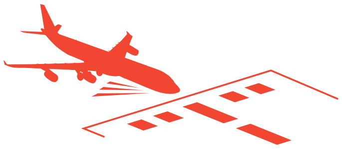
LATENT CONDITIONS

	Percentage Contribution
Regulatory Oversight	45%
Safety Management	36%
Management Decisions	18%
Flight Ops: SOPs & Checking	18%
Flight Operations	18%
Flight Ops: Training Systems	9%
Technology & Equipment	9%

THREATS

	Percentage Contribution
Meteorology	73%
Poor visibility/IMC	45%
Nav Aids	45%
Ground-based nav aid malfunction or not available	45%
Lack of visual reference	36%
Wind/Wind shear/Gusty wind	36%
Optical Illusion/visual misperception	27%
Operational Pressure	18%
Airport Facilities	18%
Thunderstorms	18%
Poor/faint marking/signs or runway/taxiway closure	18%
Terrain/Obstacles	9%
Air Traffic Services	9%

Undershoot



FLIGHT CREW ERRORS

	Percentage Contribution
SOP Adherence/SOP Cross-verification	45%
Manual Handling/Flight Controls	45%
Pilot-to-Pilot Communication	27%
Callouts	18%

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Vertical/Lateral/Speed Deviation	55%
Unnecessary Weather Penetration	36%
Continued Landing after Unstable Approach	18%
Unstable Approach	18%
Operation Outside Aircraft Limitations	9%
Engine	9%
Abrupt Aircraft Control	9%
Long/floated/bounced/firm/off-center/crabbed landing	9%

COUNTERMEASURES

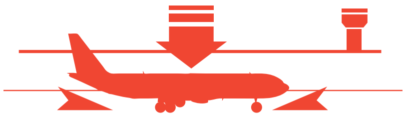
	Percentage Contribution
Overall Crew Performance	36%
Monitor/Cross-check	27%
Leadership	18%
FO is assertive when necessary	18%
Automation Management	9%
In-flight decision-making/contingency management	9%
Captain should show leadership	9%
Communication Environment	9%

Note: one accident was not classified due to insufficient data; this accident was subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum A

Top Contributing Factors – Section 4

Hard Landing



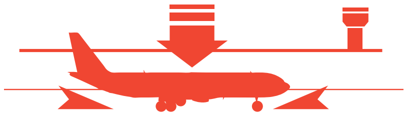
LATENT CONDITIONS

	Percentage Contribution
Flight Operations	24%
Flight Ops: Training Systems	21%
Regulatory Oversight	18%
Safety Management	11%
Flight Ops: SOPs & Checking	11%
Selection Systems	8%
Technology & Equipment	3%
Management Decisions	3%

THREATS

	Percentage Contribution
Meteorology	42%
Wind/Wind shear/Gusty wind	29%
Thunderstorms	18%
Poor visibility/IMC	13%
Lack of visual reference	11%
Operational Pressure	8%
Poor/faint marking/signs or runway/taxiway closure	5%
Airport Facilities	5%
Fatigue	5%
Optical Illusion/visual misperception	5%
Nav Aids	5%
Ground-based nav aid malfunction or not available	5%
Aircraft Malfunction	3%
Gear/Tire	3%
Dispatch/Paperwork	3%

Hard Landing



FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	71%
SOP Adherence/SOP Cross-verification	37%
Failure to GOA after abnormal runway contact	11%
Callouts	8%
Automation	8%
Crew to External Communication	5%
Pilot-to-Pilot Communication	5%
Normal Checklist	3%
Maintenance	3%
ATC	3%

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Long/floated/bounced/firm/off-center/crabbed landing	45%
Unstable Approach	39%
Vertical/Lateral/Speed Deviation	37%
Abrupt Aircraft Control	32%
Continued Landing after Unstable Approach	29%
Unnecessary Weather Penetration	16%
Operation Outside Aircraft Limitations	8%
Loss of aircraft control while on the ground	5%
Brakes/Thrust Reversers/Ground Spoilers	3%
Engine	3%
Flight Controls/Automation	3%

COUNTERMEASURES

	Percentage Contribution
Overall Crew Performance	37%
Monitor/Cross-check	21%
Captain should show leadership	11%
In-flight decision-making/contingency management	11%
Leadership	11%
Automation Management	8%
Workload Management	3%
Evaluation of Plans	3%

Note: all of the accidents were classified.

Addendum A

Top Contributing Factors – Section 4

Gear-up Landing/Gear Collapse

LATENT CONDITIONS

	Percentage Contribution
Maintenance Operations	39%
Maintenance Ops: SOPs & Checking	36%
Regulatory Oversight	25%
Safety Management	19%
Design	14%
Flight Operations	8%
Flight Ops: Training Systems	6%
Management Decisions	6%
Flight Ops: SOPs & Checking	6%
Selection Systems	6%
Maintenance Ops: Training Systems	3%
Dispatch	3%
Cabin Operations	3%
Ops Planning & Scheduling	3%
Dispatch Ops: SOPs & Checking	3%

THREATS

	Percentage Contribution
Aircraft Malfunction	78%
Gear/Tire	75%
Maintenance Events	42%
Hydraulic System Failure	6%
Airport Facilities	3%
Inad overrun area/trench/ditch/prox of structures	3%
Wind/Wind shear/Gusty wind	3%
Dispatch/Paperwork	3%
Nav Aids	3%
Ground-based nav aid malfunction or not available	3%
Meteorology	3%
Operational Pressure	3%
Poor visibility/IMC	3%
Electrical Power Generation Failure	3%
Thunderstorms	3%

Gear-up Landing/Gear Collapse

FLIGHT CREW ERRORS

	Percentage Contribution
Abnormal Checklist	6%
SOP Adherence/SOP Cross-verification	6%
Systems/Radios/Instruments	3%

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Landing Gear	6%
Unnecessary Weather Penetration	3%
Unstable Approach	3%
Systems	3%
Vertical/Lateral/Speed Deviation	3%
Long/floated/bounced/firm/off-center/crabbed landing	3%
Operation Outside Aircraft Limitations	3%

COUNTERMEASURES

	Percentage Contribution
In-flight decision-making/contingency management	6%
Evaluation of Plans	3%
Captain should show leadership	3%
Communication Environment	3%
Overall Crew Performance	3%
Leadership	3%
Monitor/Cross-check	3%
Workload Management	3%
FO is assertive when necessary	3%

Note: three accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum A

Top Contributing Factors – Section 4

Tail Strike

LATENT CONDITIONS

	Percentage Contribution
Flight Operations	21%
Safety Management	11%
Flight Ops: Training Systems	11%
Dispatch	5%
Ops Planning & Scheduling	5%
Flight Ops: SOPs & Checking	5%

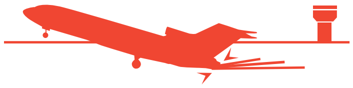
THREATS

	Percentage Contribution
Wind/Wind shear/Gusty wind	26%
Meteorology	26%
Dispatch/Paperwork	11%
Thunderstorms	5%
Optical Illusion/visual misperception	5%
Poor visibility/IMC	5%
Ground Events	5%
Terrain/Obstacles	5%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	74%
SOP Adherence/SOP Cross-verification	53%
Failure to GOA after abnormal runway contact	32%
Pilot-to-Pilot Communication	16%
Wrong Weight & Balance/Fuel Information	11%
Callouts	11%
Documentation	11%
Systems/Radios/Instruments	5%
Normal Checklist	5%

Tail Strike



UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Long/floated/bounced/firm/off-center/crabbed landing	63%
Vertical/Lateral/Speed Deviation	32%
Abrupt Aircraft Control	32%
Unstable Approach	21%
Continued Landing after Unstable Approach	16%
Weight & Balance	5%
Brakes/Thrust Reversers/Ground Spoilers	5%
Operation Outside Aircraft Limitations	5%
Unnecessary Weather Penetration	5%

COUNTERMEASURES

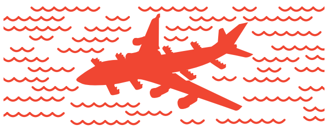
	Percentage Contribution
Monitor/Cross-check	37%
Overall Crew Performance	32%
Leadership	21%
Captain should show leadership	21%
In-flight decision-making/contingency management	16%
Workload Management	11%
Communication Environment	11%
Automation Management	5%
FO is assertive when necessary	5%
Evaluation of Plans	5%

Note: two accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum A

Top Contributing Factors – Section 4

Off-Airport Landing/Ditching

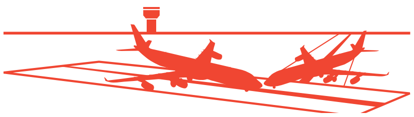


At least three accidents are required before the accident classification is provided.
This category only contained one accident in the past 5 years.

Addendum A

Top Contributing Factors – Section 4

Runway Collision



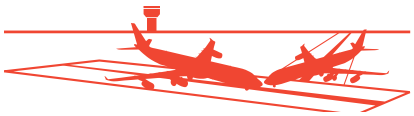
LATENT CONDITIONS

	Percentage Contribution
Regulatory Oversight	83%
Safety Management	50%
Flight Ops: Training Systems	17%
Maintenance Operations	17%
Management Decisions	17%
Maintenance Ops: SOPs & Checking	17%
Flight Operations	17%

THREATS

	Percentage Contribution
Air Traffic Services	50%
Airport Facilities	50%
Meteorology	33%
Airport perimeter control/fencing/wildlife control	33%
Poor visibility/IMC	33%
Lack of visual reference	17%
Icing Conditions	17%
Traffic	17%
Contaminated runway/taxiway - poor braking action	17%
Wildlife/Birds/Foreign Object	17%
Wind/Wind shear/Gusty wind	17%

Runway Collision



FLIGHT CREW ERRORS

	Percentage Contribution
ATC	17%
Callouts	17%
Briefings	17%
Ground Navigation	17%
SOP Adherence/SOP Cross-verification	17%
Crew to External Communication	17%

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Runway/taxiway incursion	33%
Ramp movements	17%

COUNTERMEASURES

	Percentage Contribution
Inquiry	17%
Monitor/Cross-check	17%
Overall Crew Performance	17%

Note: all of the accidents were classified.

Addendum A

Top Contributing Factors – Section 4

Jet Aircraft Accidents

LATENT CONDITIONS

	Percentage Contribution
Safety Management	31%
Regulatory Oversight	30%
Flight Operations	20%
Flight Ops: Training Systems	14%
Flight Ops: SOPs & Checking	14%
Maintenance Operations	12%
Maintenance Ops: SOPs & Checking	11%
Selection Systems	9%
Design	9%
Ground Operations	5%
Technology & Equipment	4%
Management Decisions	4%
Dispatch	3%
Ground Ops: SOPs & Checking	3%
Dispatch Ops: SOPs & Checking	3%
Ground Ops: Training Systems	2%
Change Management	2%
Ops Planning & Scheduling	2%
Maintenance Ops: Training Systems	1%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	40%
SOP Adherence/SOP Cross-verification	32%
Callouts	12%
Pilot-to-Pilot Communication	11%
Failure to GOA after abnormal runway contact	7%
Automation	5%
Abnormal Checklist	3%
Ground Navigation	3%
Crew to External Communication	3%
Systems/Radios/Instruments	2%
Documentation	2%
Normal Checklist	2%
Wrong Weight & Balance/Fuel Information	2%
Briefings	2%
ATC	2%
Ground Crew	1%
Dispatch	1%
Maintenance	1%

Jet Aircraft Accidents

THREATS

	Percentage Contribution
Meteorology	34%
Aircraft Malfunction	27%
Wind/Wind shear/Gusty wind	21%
Airport Facilities	20%
Maintenance Events	17%
Thunderstorms	14%
Gear/Tire	13%
Contaminated runway/taxiway - poor braking action	13%
Poor visibility/IMC	11%
Operational Pressure	9%
Ground Events	8%
Lack of visual reference	7%
Wildlife/Birds/Foreign Object	5%
Fire/Smoke (Cockpit/Cabin/Cargo)	5%
Fatigue	5%
Air Traffic Services	5%
Optical Illusion/visual misperception	4%
Ground-based nav aid malfunction or not available	4%
Poor/faint marking/signs or runway/taxiway closure	4%
Nav Aids	4%
Traffic	4%
Inad overrun area/trench/ditch/prox of structures	3%
Extensive/Uncontained Engine Failure	3%
Icing Conditions	3%
Dispatch/Paperwork	3%
MEL Item	2%
Spatial Disorientation/somatogravic illusion	2%
Hydraulic System Failure	2%
Brakes	2%
Crew Incapacitation	1%
Avionics/Flight Instruments	1%
Manuals/Charts/Checklists	1%
Contained Engine Failure/Powerplant Malfunction	1%
Airport perimeter control/fencing/wildlife control	1%
Flight Controls	1%
Primary Flight Controls	1%

Jet Aircraft Accidents

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Long/floated/bounced/firm/off-center/crabbed landing	26%
Vertical/Lateral/Speed Deviation	23%
Unstable Approach	18%
Continued Landing after Unstable Approach	14%
Abrupt Aircraft Control	12%
Unnecessary Weather Penetration	11%
Operation Outside Aircraft Limitations	8%
Brakes/Thrust Reversers/Ground Spoilers	6%
Flight Controls/Automation	4%
Engine	3%
Ramp movements	3%
Loss of aircraft control while on the ground	2%
Controlled Flight Toward Terrain	2%
Weight & Balance	2%
Rejected Takeoff after V_1	1%
Unauthorized Airspace Penetration	1%
Runway/taxiway incursion	1%
Systems	1%
Wrong taxiway/ramp/gate/hold spot	1%

COUNTERMEASURES

	Percentage Contribution
Overall Crew Performance	27%
Monitor/Cross-check	19%
Leadership	14%
In-flight decision-making/contingency management	14%
Captain should show leadership	12%
Taxiway/Runway Management	11%
Automation Management	7%
Workload Management	6%
FO is assertive when necessary	6%
Communication Environment	4%
Evaluation of Plans	3%
SOP Briefing/Planning	1%
Inquiry	1%
Plans Stated	1%

Note: 16 accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum A

Top Contributing Factors – Section 4

Turboprop Aircraft Accidents

LATENT CONDITIONS

	Percentage Contribution
Regulatory Oversight	37%
Safety Management	30%
Flight Operations	27%
Flight Ops: SOPs & Checking	17%
Flight Ops: Training Systems	13%
Selection Systems	13%
Management Decisions	12%
Maintenance Operations	8%
Maintenance Ops: SOPs & Checking	8%
Ops Planning & Scheduling	4%
Ground Ops: SOPs & Checking	2%
Ground Ops: Training Systems	2%
Technology & Equipment	2%
Ground Operations	2%
Cabin Operations	1%
Maintenance Ops: Training Systems	1%
Change Management	1%
Dispatch	1%
Design	1%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	37%
SOP Adherence/SOP Cross-verification	31%
Callouts	10%
Abnormal Checklist	7%
Pilot-to-Pilot Communication	7%
Failure to GOA after abnormal runway contact	4%
Briefings	2%
ATC	2%
Systems/Radios/Instruments	2%
Normal Checklist	2%
Crew to External Communication	2%
Automation	1%
Ground Navigation	1%

Turboprop Aircraft Accidents

THREATS

	Percentage Contribution
Meteorology	39%
Aircraft Malfunction	34%
Wind/Wind shear/Gusty wind	22%
Poor visibility/IMC	18%
Airport Facilities	17%
Gear/Tire	14%
Thunderstorms	14%
Ground-based nav aid malfunction or not available	11%
Nav Aids	11%
Operational Pressure	10%
Contained Engine Failure/Powerplant Malfunction	8%
Airport perimeter control/fencing/wildlife control	6%
Inad overrun area/trench/ditch/prox of structures	6%
Lack of visual reference	6%
Fatigue	6%
Terrain/Obstacles	6%
Air Traffic Services	5%
Poor/faint marking/signs or runway/taxiway closure	5%
Wildlife/Birds/Foreign Object	5%
Maintenance Events	5%
Dispatch/Paperwork	4%
Optical Illusion/visual misperception	4%
Ground Events	4%
Fire/Smoke (Cockpit/Cabin/Cargo)	4%
Icing Conditions	2%
Structural Failure	1%
Extensive/Uncontained Engine Failure	1%
Contaminated runway/taxiway - poor braking action	1%
Traffic	1%
Crew Incapacitation	1%
Avionics/Flight Instruments	1%
Electrical Power Generation Failure	1%
Manuals/Charts/Checklists	1%

Turboprop Aircraft Accidents

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Vertical/Lateral/Speed Deviation	23%
Unnecessary Weather Penetration	19%
Long/floated/bounced/firm/off-center/crabbed landing	19%
Abrupt Aircraft Control	17%
Unstable Approach	14%
Operation Outside Aircraft Limitations	12%
Continued Landing after Unstable Approach	12%
Engine	7%
Controlled Flight Toward Terrain	6%
Loss of aircraft control while on the ground	6%
Brakes/Thrust Reversers/Ground Spoilers	4%
Rejected Takeoff after V_1	2%
Flight Controls/Automation	2%
Landing Gear	2%
Runway/taxiway incursion	1%
Unauthorized Airspace Penetration	1%
Systems	1%

COUNTERMEASURES

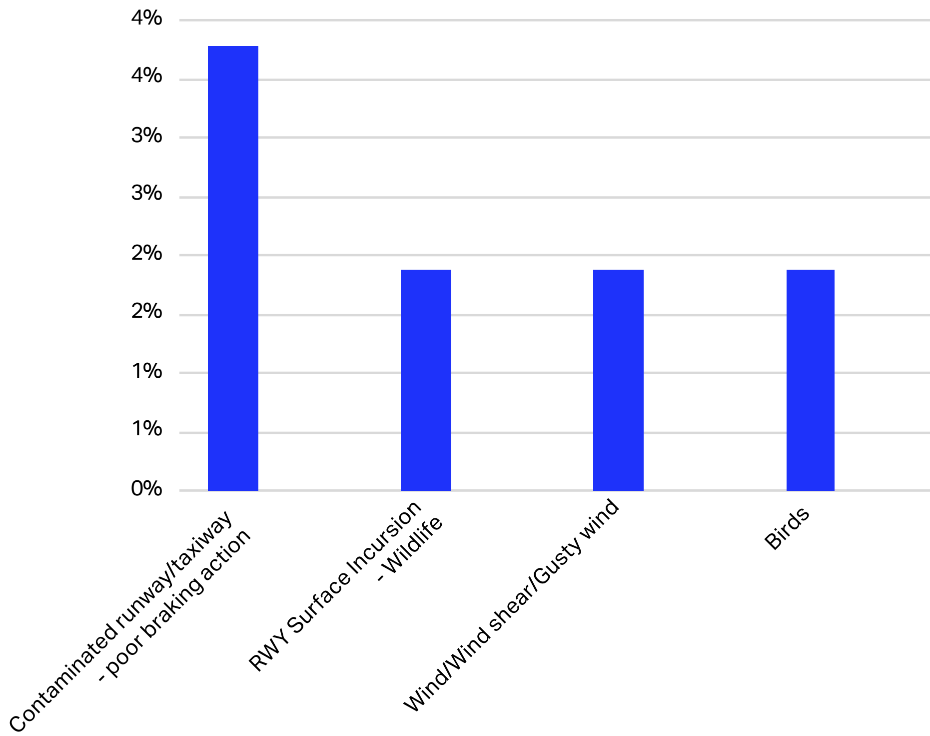
	Percentage Contribution
Overall Crew Performance	27%
Monitor/Cross-check	24%
In-flight decision-making/contingency management	14%
Leadership	12%
Captain should show leadership	12%
Workload Management	7%
FO is assertive when necessary	7%
Evaluation of Plans	6%
Communication Environment	6%
Taxiway/Runway Management	2%
Inquiry	1%
Automation Management	1%

Note: 12 accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

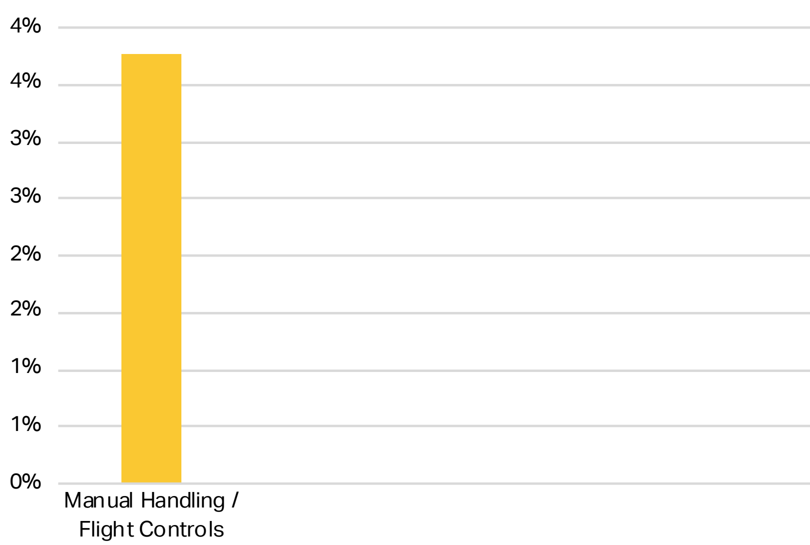
2019 Primary Contributing Factors

Accident Primary Contributing Factors Distribution

THREATS

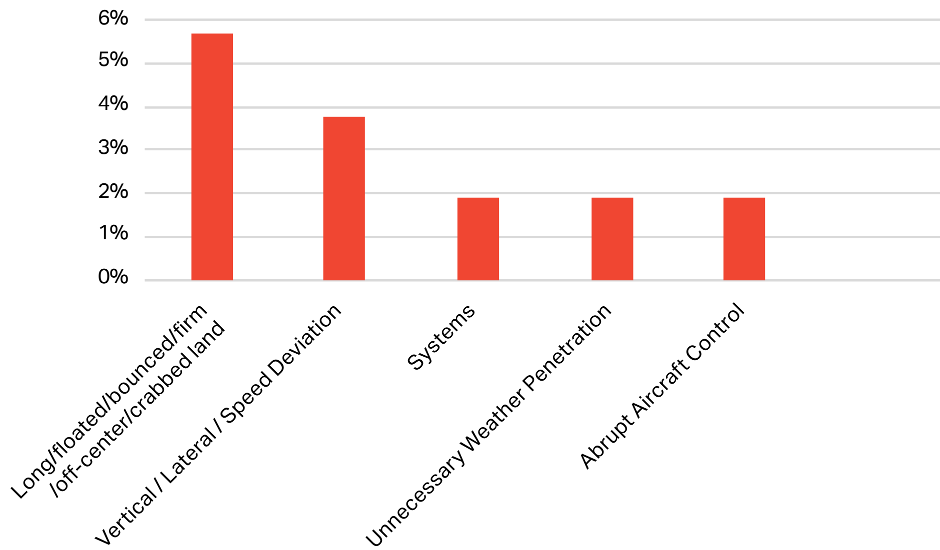


FLIGHT CREW ERRORS

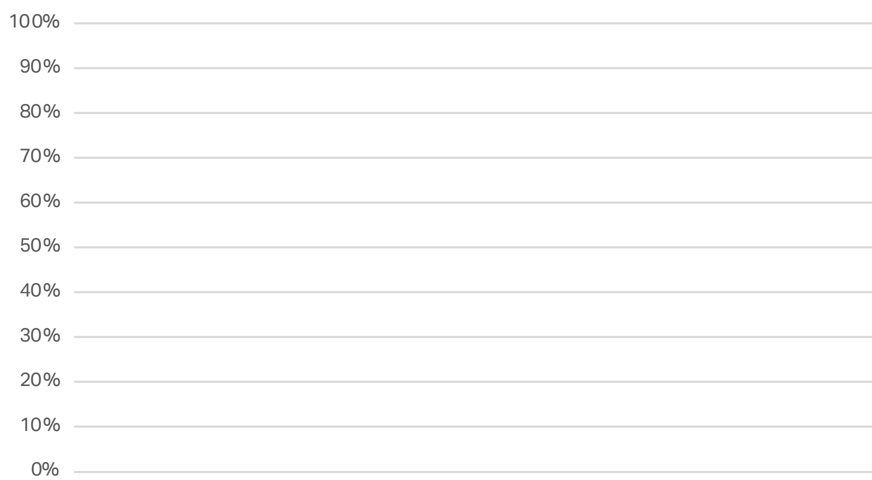


Accident Primary Contributing Factors Distribution

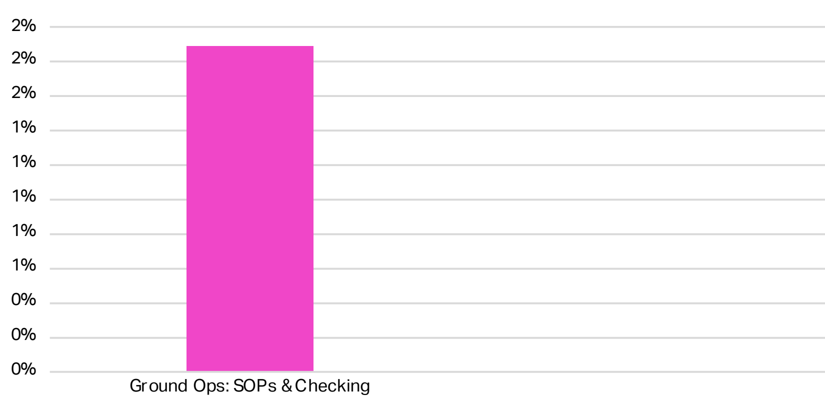
UNDESIRED AIRCRAFT STATE



COUNTERMEASURES



LATENT CONDITIONS

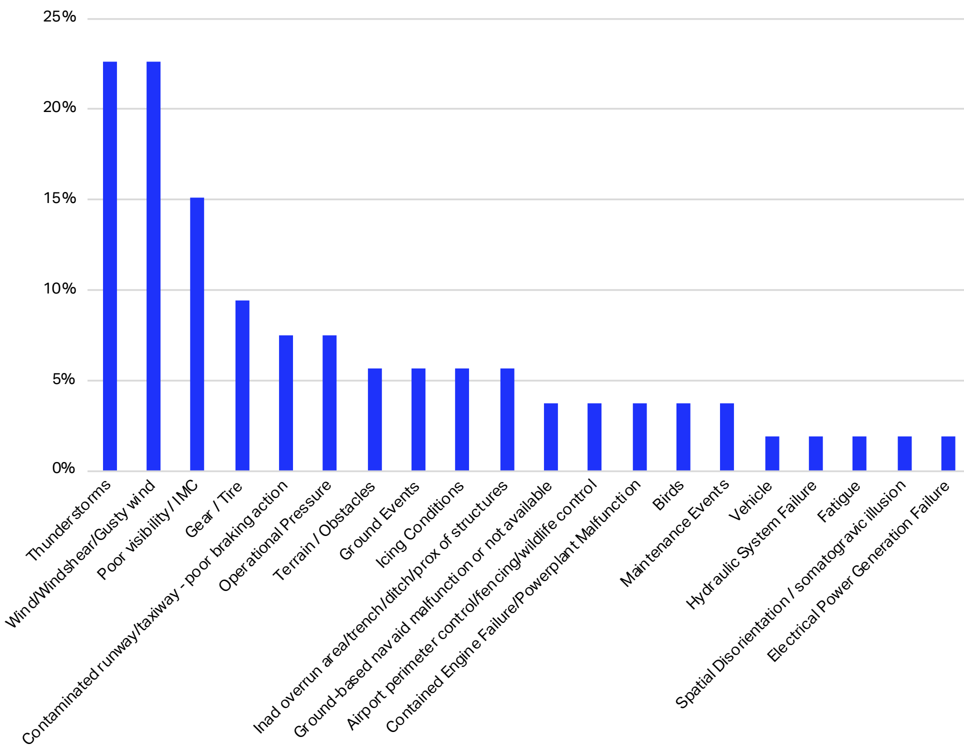


Addendum B

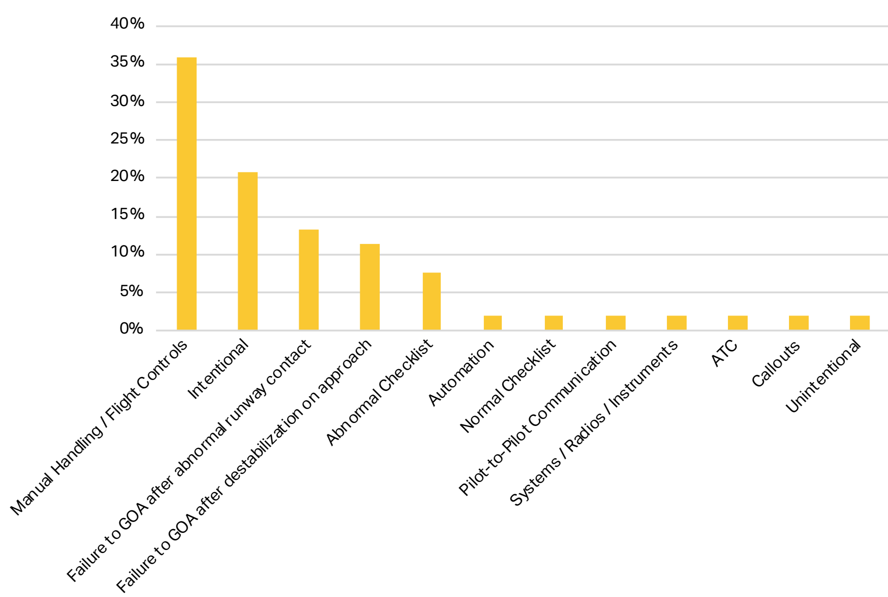
2019 Secondary Contributing Factors

Accident Secondary Contributing Factors Distribution

THREATS

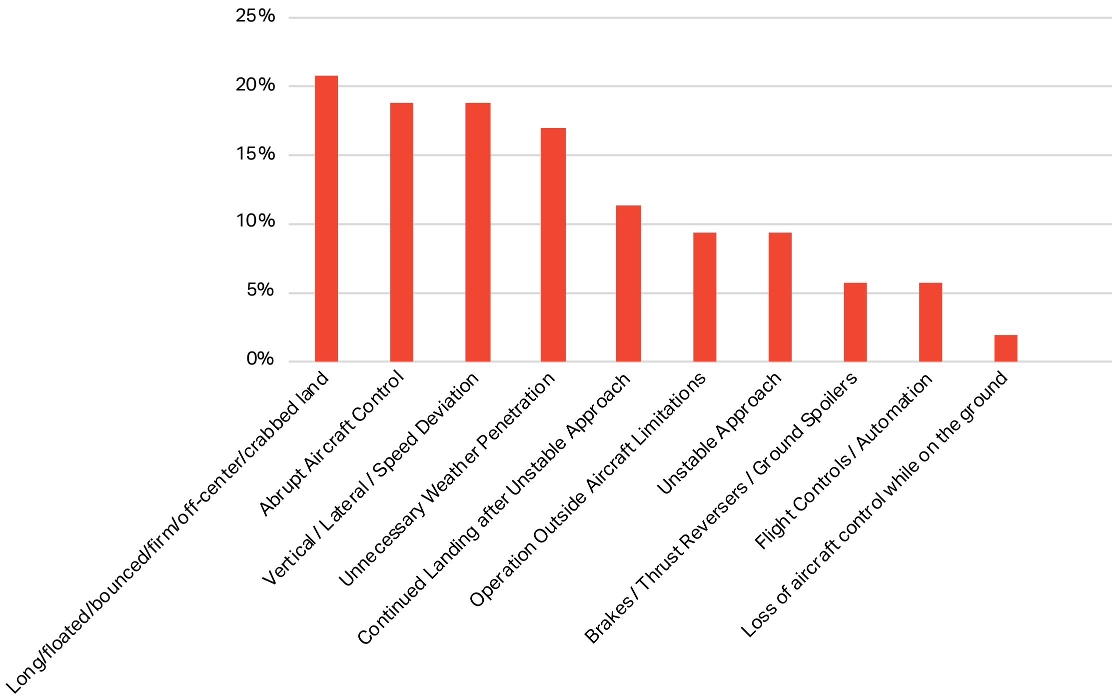


FLIGHT CREW ERRORS

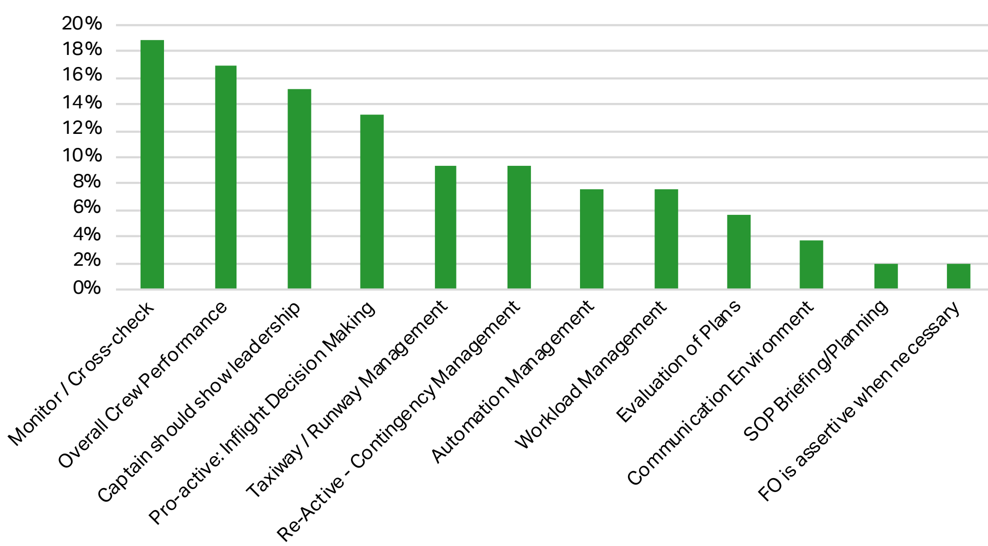


Accident Secondary Contributing Factors Distribution

UNDESIRED AIRCRAFT STATE

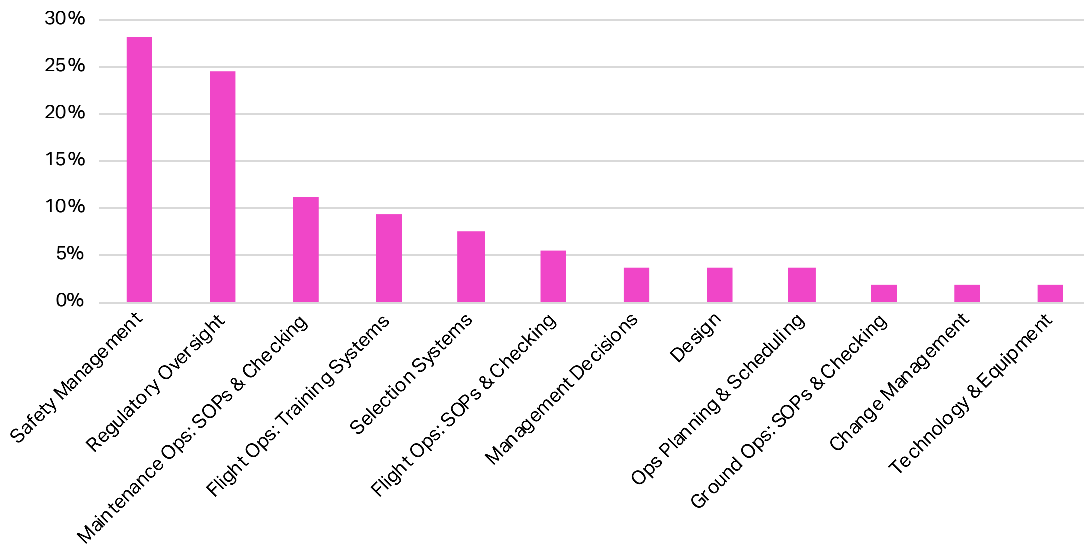


COUNTERMEASURES



Accident Secondary Contributing Factors Distribution

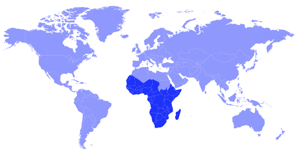
LATENT CONDITIONS



Addendum C

Top Contributing Factors – Section 5

Africa Aircraft Accidents



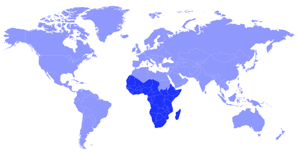
LATENT CONDITIONS

	Percentage Contribution
Regulatory Oversight	39%
Safety Management	35%
Management Decisions	13%
Maintenance Ops: SOPs & Checking	9%
Maintenance Operations	9%
Design	4%
Flight Operations	4%
Technology & Equipment	4%
Flight Ops: Training Systems	4%
Change Management	4%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	26%
Crew to External Communication	9%
SOP Adherence/SOP Cross-verification	9%
ATC	9%
Automation	4%
Abnormal Checklist	4%
Ground Navigation	4%

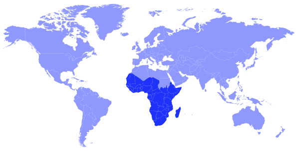
Africa Aircraft Accidents



THREATS

	Percentage Contribution
Airport Facilities	35%
Aircraft Malfunction	22%
Meteorology	22%
Wildlife/Birds/Foreign Object	22%
Wind/Wind shear/Gusty wind	17%
Thunderstorms	17%
Maintenance Events	13%
Gear/Tire	13%
Airport perimeter control/fencing/wildlife control	13%
Poor visibility/IMC	9%
Poor/faint marking/signs or runway/taxiway closure	9%
Nav Aids	9%
Contaminated runway/taxiway - poor braking action	9%
Ground-based nav aid malfunction or not available	9%
Lack of visual reference	4%
Extensive/Uncontained Engine Failure	4%
Ground Events	4%
Inad overrun area/trench/ditch/prox of structures	4%
Crew Incapacitation	4%

Africa Aircraft Accidents



UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Long/floated/bounced/firm/off-center/crabbed landing	22%
Vertical/Lateral/Speed Deviation	22%
Unnecessary Weather Penetration	17%
Continued Landing after Unstable Approach	9%
Abrupt Aircraft Control	9%
Flight Controls/Automation	4%
Unstable Approach	4%
Operation Outside Aircraft Limitations	4%
Brakes/Thrust Reversers/Ground Spoilers	4%
Unauthorized Airspace Penetration	4%
Loss of aircraft control while on the ground	4%
Ramp movements	4%

COUNTERMEASURES

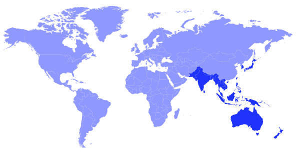
	Percentage Contribution
In-flight decision-making/contingency management	17%
Overall Crew Performance	17%
Captain should show leadership	13%
Leadership	13%
Automation Management	9%
Workload Management	9%
Taxiway/Runway Management	9%
Monitor/Cross-check	9%

Note: 10 accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum C

Top Contributing Factors – Section 5

Asia/Pacific Aircraft Accidents



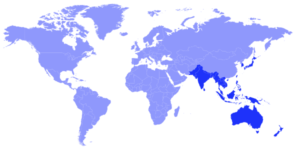
LATENT CONDITIONS

	Percentage Contribution
Regulatory Oversight	55%
Safety Management	42%
Flight Operations	25%
Flight Ops: Training Systems	20%
Flight Ops: SOPs & Checking	14%
Selection Systems	14%
Maintenance Operations	12%
Maintenance Ops: SOPs & Checking	11%
Technology & Equipment	5%
Design	5%
Management Decisions	3%
Maintenance Ops: Training Systems	2%
Change Management	2%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	49%
SOP Adherence/SOP Cross-verification	43%
Callouts	20%
Pilot-to-Pilot Communication	18%
Crew to External Communication	6%
Ground Navigation	6%
Abnormal Checklist	5%
ATC	3%
Briefings	3%
Maintenance	2%
Normal Checklist	2%
Automation	2%
Systems/Radios/Instruments	2%
Ground Crew	2%

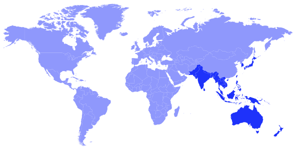
Asia/Pacific Aircraft Accidents



THREATS

	Percentage Contribution
Meteorology	35%
Airport Facilities	25%
Aircraft Malfunction	20%
Thunderstorms	17%
Poor visibility/IMC	15%
Wind/Wind shear/Gusty wind	12%
Maintenance Events	12%
Ground-based nav aid malfunction or not available	11%
Contaminated runway/taxiway - poor braking action	11%
Nav Aids	11%
Poor/faint marking/signs or runway/taxiway closure	11%
Lack of visual reference	11%
Operational Pressure	9%
Air Traffic Services	8%
Fire/Smoke (Cockpit/Cabin/Cargo)	6%
Optical Illusion/visual misperception	6%
Contained Engine Failure/Powerplant Malfunction	6%
Fatigue	5%
Inad overrun area/trench/ditch/prox of structures	5%
Gear/Tire	5%
Ground Events	3%
Terrain/Obstacles	3%
Crew Incapacitation	3%
Wildlife/Birds/Foreign Object	3%
Traffic	3%
Airport perimeter control/fencing/wildlife control	2%
Dispatch/Paperwork	2%
Extensive/Uncontained Engine Failure	2%
Avionics/Flight Instruments	2%
Manuals/Charts/Checklists	2%

Asia/Pacific Aircraft Accidents



UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Vertical/Lateral/Speed Deviation	32%
Long/floated/bounced/firm/off-center/crabbed landing	31%
Unstable Approach	31%
Continued Landing after Unstable Approach	25%
Abrupt Aircraft Control	14%
Unnecessary Weather Penetration	14%
Operation Outside Aircraft Limitations	8%
Ramp movements	8%
Controlled Flight Toward Terrain	6%
Engine	6%
Brakes/Thrust Reversers/Ground Spoilers	6%
Flight Controls/Automation	5%
Runway/taxiway incursion	3%
Loss of aircraft control while on the ground	2%
Unauthorized Airspace Penetration	2%

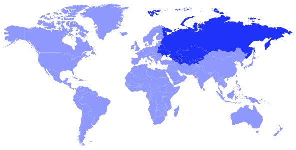
COUNTERMEASURES

	Percentage Contribution
Overall Crew Performance	37%
Monitor/Cross-check	26%
Leadership	20%
Captain should show leadership	15%
Taxiway/Runway Management	14%
FO is assertive when necessary	12%
In-flight decision-making/contingency management	9%
Workload Management	6%
Automation Management	5%
Communication Environment	5%
Inquiry	2%

Note: four accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Top Contributing Factors – Section 5

Commonwealth of Independent States Aircraft Accidents



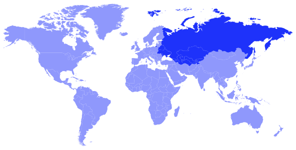
LATENT CONDITIONS

	Percentage Contribution
Safety Management	37%
Regulatory Oversight	30%
Flight Operations	26%
Flight Ops: SOPs & Checking	22%
Flight Ops: Training Systems	11%
Maintenance Operations	7%
Ground Operations	7%
Ground Ops: SOPs & Checking	7%
Ground Ops: Training Systems	4%
Dispatch	4%
Selection Systems	4%
Ops Planning & Scheduling	4%
Management Decisions	4%
Dispatch Ops: SOPs & Checking	4%
Maintenance Ops: SOPs & Checking	4%

FLIGHT CREW ERRORS

	Percentage Contribution
SOP Adherence/SOP Cross-verification	48%
Manual Handling/Flight Controls	48%
Callouts	7%
Normal Checklist	7%
Systems/Radios/Instruments	4%
Abnormal Checklist	4%
Documentation	4%
Pilot-to-Pilot Communication	4%
Wrong Weight & Balance/Fuel Information	4%
Briefings	4%

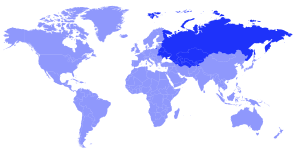
Commonwealth of Independent States Aircraft Accidents



THREATS

	Percentage Contribution
Meteorology	52%
Airport Facilities	37%
Aircraft Malfunction	26%
Wind/Wind shear/Gusty wind	26%
Thunderstorms	26%
Inad overrun area/trench/ditch/prox of structures	15%
Contained Engine Failure/Powerplant Malfunction	15%
Operational Pressure	15%
Contaminated runway/taxiway - poor braking action	15%
Poor visibility/IMC	15%
Icing Conditions	11%
Dispatch/Paperwork	7%
Ground Events	7%
Maintenance Events	7%
Gear/Tire	7%
Airport perimeter control/fencing/wildlife control	7%
Wildlife/Birds/Foreign Object	7%
Lack of visual reference	7%
MEL Item	7%
Optical Illusion/visual misperception	7%
Air Traffic Services	7%
Spatial Disorientation/somatogravic illusion	4%
Poor/faint marking/signs or runway/taxiway closure	4%
Ground-based nav aid malfunction or not available	4%
Fire/Smoke (Cockpit/Cabin/Cargo)	4%
Fatigue	4%
Nav Aids	4%

Commonwealth of Independent States Aircraft Accidents



UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Long/floated/bounced/firm/off-center/crabbed land	33%
Unnecessary Weather Penetration	26%
Unstable Approach	15%
Brakes/Thrust Reversers/Ground Spoilers	15%
Continued Landing after Unstable Approach	11%
Abrupt Aircraft Control	11%
Vertical/Lateral/Speed Deviation	7%
Operation Outside Aircraft Limitations	7%
Systems	4%
Loss of aircraft control while on the ground	4%
Rejected Takeoff after V_1	4%

COUNTERMEASURES

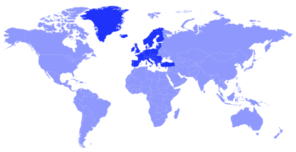
	Percentage Contribution
Overall Crew Performance	30%
In-flight decision-making/contingency management	22%
Monitor/Cross-check	15%
Taxiway/Runway Management	11%
Captain should show leadership	11%
Leadership	11%
Evaluation of Plans	7%
Communication Environment	4%
SOP Briefing/Planning	4%

Note: one accident was not classified due to insufficient data; this accident was subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum C

Top Contributing Factors – Section 5

Europe Aircraft Accidents



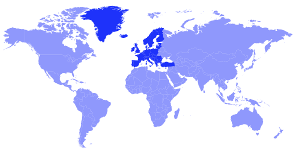
LATENT CONDITIONS

	Percentage Contribution
Flight Operations	21%
Flight Ops: Training Systems	18%
Flight Ops: SOPs & Checking	13%
Regulatory Oversight	13%
Safety Management	13%
Selection Systems	10%
Ground Operations	10%
Design	8%
Maintenance Operations	5%
Technology & Equipment	5%
Ground Ops: SOPs & Checking	5%
Ground Ops: Training Systems	5%
Maintenance Ops: SOPs & Checking	5%
Change Management	5%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	44%
SOP Adherence/SOP Cross-verification	36%
Callouts	15%
Automation	10%
Pilot-to-Pilot Communication	5%
Abnormal Checklist	3%
Systems/Radios/Instruments	3%

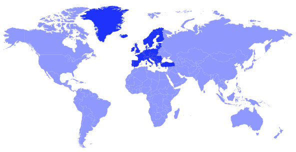
Europe Aircraft Accidents



THREATS

	Percentage Contribution
Meteorology	36%
Aircraft Malfunction	31%
Wind/Wind shear/Gusty wind	28%
Gear/Tire	18%
Fatigue	15%
Ground Events	10%
Operational Pressure	10%
Airport Facilities	10%
Poor visibility/IMC	10%
Lack of visual reference	10%
Thunderstorms	8%
Contaminated runway/taxiway - poor braking action	8%
Maintenance Events	5%
Traffic	5%
Extensive/Uncontained Engine Failure	5%
Wildlife/Birds/Foreign Object	3%
Icing Conditions	3%
Avionics/Flight Instruments	3%
Hydraulic System Failure	3%
Contained Engine Failure/Powerplant Malfunction	3%
Fire/Smoke (Cockpit/Cabin/Cargo)	3%
Air Traffic Services	3%
Inad overrun area/trench/ditch/prox of structures	3%
Manuals/Charts/Checklists	3%
Optical Illusion/visual misperception	3%
Brakes	3%
MEL Item	3%

Europe Aircraft Accidents



UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Vertical/Lateral/Speed Deviation	28%
Long/floated/bounced/firm/off-center/crabbed landing	26%
Unstable Approach	18%
Abrupt Aircraft Control	18%
Continued Landing after Unstable Approach	15%
Unnecessary Weather Penetration	10%
Loss of aircraft control while on the ground	5%
Landing Gear	3%
Flight Controls/Automation	3%
Controlled Flight Toward Terrain	3%
Engine	3%
Brakes/Thrust Reversers/Ground Spoilers	3%
Operation Outside Aircraft Limitations	3%

COUNTERMEASURES

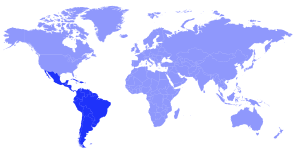
	Percentage Contribution
Overall Crew Performance	31%
Monitor/Cross-check	21%
In-flight decision-making/contingency management	13%
Captain should show leadership	8%
Leadership	8%
Automation Management	8%
Communication Environment	3%
FO is assertive when necessary	3%
Taxiway/Runway Management	3%

Note: three accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum C

Top Contributing Factors – Section 5

Latin America & the Caribbean Aircraft Accidents



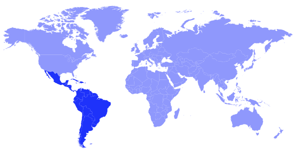
LATENT CONDITIONS

	Percentage Contribution
Safety Management	38%
Regulatory Oversight	38%
Flight Operations	31%
Selection Systems	24%
Dispatch	21%
Flight Ops: SOPs & Checking	21%
Maintenance Operations	17%
Maintenance Ops: SOPs & Checking	17%
Management Decisions	17%
Dispatch Ops: SOPs & Checking	14%
Design	10%
Flight Ops: Training Systems	10%
Ops Planning & Scheduling	7%
Cabin Operations	3%

FLIGHT CREW ERRORS

	Percentage Contribution
SOP Adherence/SOP Cross-verification	24%
Manual Handling/Flight Controls	21%
Callouts	10%
Wrong Weight & Balance/Fuel Information	10%
Documentation	10%
Pilot-to-Pilot Communication	7%
Systems/Radios/Instruments	7%
Abnormal Checklist	7%
Normal Checklist	3%
Briefings	3%
Crew to External Communication	3%
ATC	3%
Dispatch	3%

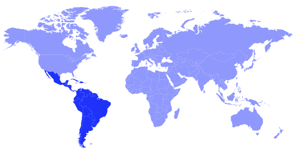
Latin America & the Caribbean Aircraft Accidents



THREATS

	Percentage Contribution
Aircraft Malfunction	41%
Maintenance Events	24%
Gear/Tire	21%
Meteorology	21%
Dispatch/Paperwork	17%
Airport Facilities	14%
Operational Pressure	14%
Poor visibility/IMC	10%
Thunderstorms	10%
Ground-based nav aid malfunction or not available	7%
Nav Aids	7%
Lack of visual reference	7%
Wind/Wind shear/Gusty wind	7%
Contaminated runway/taxiway - poor braking action	7%
Manuals/Charts/Checklists	3%
Hydraulic System Failure	3%
Brakes	3%
Fire/Smoke (Cockpit/Cabin/Cargo)	3%
Air Traffic Services	3%
Terrain/Obstacles	3%
Inad overrun area/trench/ditch/prox of structures	3%
Optical Illusion/visual misperception	3%
Ground Events	3%
Electrical Power Generation Failure	3%
Airport perimeter control/fencing/wildlife control	3%
Wildlife/Birds/Foreign Object	3%
Poor/faint marking/signs or runway/taxiway closure	3%

Latin America & the Caribbean Aircraft Accidents



UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Unnecessary Weather Penetration	14%
Operation Outside Aircraft Limitations	14%
Abrupt Aircraft Control	10%
Long/floated/bounced/firm/off-center/crabbed landing	10%
Weight & Balance	10%
Vertical/Lateral/Speed Deviation	7%
Engine	3%
Brakes/Thrust Reversers/Ground Spoilers	3%
Landing Gear	3%
Systems	3%
Rejected Takeoff after V_1	3%
Unstable Approach	3%
Controlled Flight Toward Terrain	3%

COUNTERMEASURES

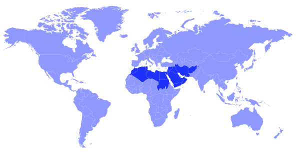
	Percentage Contribution
Monitor/Cross-check	21%
In-flight decision-making/contingency management	21%
Overall Crew Performance	17%
FO is assertive when necessary	10%
Leadership	10%
Captain should show leadership	10%
Workload Management	10%
Communication Environment	7%
Evaluation of Plans	7%
Taxiway/Runway Management	3%
Plans Stated	3%
Inquiry	3%

Note: three accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum C

Top Contributing Factors – Section 5

Middle East & North Africa Aircraft Accidents



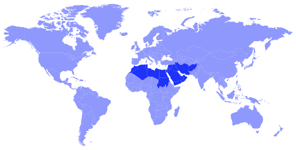
LATENT CONDITIONS

	Percentage Contribution
Safety Management	44%
Regulatory Oversight	31%
Flight Operations	25%
Flight Ops: SOPs & Checking	25%
Design	25%
Maintenance Operations	19%
Maintenance Ops: SOPs & Checking	19%
Selection Systems	13%
Maintenance Ops: Training Systems	6%
Technology & Equipment	6%
Flight Ops: Training Systems	6%
Ops Planning & Scheduling	6%
Management Decisions	6%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	38%
Callouts	25%
SOP Adherence/SOP Cross-verification	25%
Pilot-to-Pilot Communication	13%
Automation	13%
Abnormal Checklist	13%
Briefings	6%

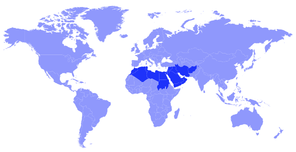
Middle East & North Africa Aircraft Accidents



THREATS

	Percentage Contribution
Aircraft Malfunction	44%
Gear/Tire	31%
Maintenance Events	31%
Meteorology	25%
Wind/Wind shear/Gusty wind	19%
Operational Pressure	13%
Poor visibility/IMC	13%
Icing Conditions	6%
Ground Events	6%
Airport Facilities	6%
Lack of visual reference	6%
Hydraulic System Failure	6%
Spatial Disorientation/somatogravic illusion	6%
Avionics/Flight Instruments	6%
Brakes	6%
Air Traffic Services	6%
Contaminated runway/taxiway - poor braking action	6%
Fatigue	6%
Terrain/Obstacles	6%
Fire/Smoke (Cockpit/Cabin/Cargo)	6%

Middle East & North Africa Aircraft Accidents



UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Operation Outside Aircraft Limitations	19%
Long/floated/bounced/firm/off-center/crabbed landing	19%
Engine	19%
Abrupt Aircraft Control	13%
Vertical/Lateral/Speed Deviation	13%
Loss of aircraft control while on the ground	13%
Brakes/Thrust Reversers/Ground Spoilers	6%
Flight Controls/Automation	6%
Unnecessary Weather Penetration	6%
Rejected Takeoff after V_1	6%
Controlled Flight Toward Terrain	6%

COUNTERMEASURES

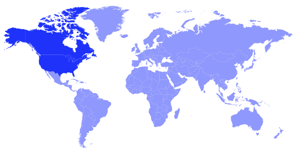
	Percentage Contribution
Overall Crew Performance	25%
Monitor/Cross-check	25%
Taxiway/Runway Management	13%
FO is assertive when necessary	13%
Communication Environment	13%
Captain should show leadership	13%
In-flight decision-making/contingency management	13%
Leadership	13%
Workload Management	6%
Automation Management	6%
Evaluation of Plans	6%

Note: one accident was not classified due to insufficient data; this accident was subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum C

Top Contributing Factors – Section 5

North America Aircraft Accidents



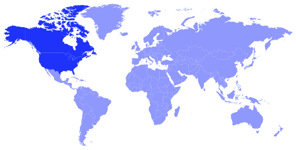
LATENT CONDITIONS

	Percentage Contribution
Safety Management	20%
Flight Operations	17%
Regulatory Oversight	17%
Maintenance Operations	11%
Flight Ops: SOPs & Checking	11%
Maintenance Ops: SOPs & Checking	11%
Flight Ops: Training Systems	7%
Ground Ops: SOPs & Checking	7%
Ground Operations	7%
Management Decisions	7%
Design	6%
Ground Ops: Training Systems	6%
Selection Systems	4%
Technology & Equipment	4%
Ops Planning & Scheduling	2%
Maintenance Ops: Training Systems	2%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	30%
SOP Adherence/SOP Cross-verification	20%
Pilot-to-Pilot Communication	7%
Automation	2%
Normal Checklist	2%
Ground Navigation	2%
Systems/Radios/Instruments	2%
Callouts	2%
Abnormal Checklist	2%

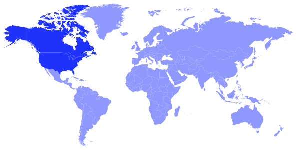
North America Aircraft Accidents



THREATS

	Percentage Contribution
Meteorology	41%
Aircraft Malfunction	31%
Wind/Wind shear/Gusty wind	28%
Gear/Tire	17%
Poor visibility/IMC	15%
Maintenance Events	13%
Ground Events	9%
Airport Facilities	9%
Thunderstorms	9%
Nav Aids	7%
Contaminated runway/taxiway - poor braking action	7%
Ground-based nav aid malfunction or not available	7%
Traffic	7%
Extensive/Uncontained Engine Failure	6%
Fatigue	6%
Icing Conditions	6%
Operational Pressure	6%
Fire/Smoke (Cockpit/Cabin/Cargo)	6%
Wildlife/Birds/Foreign Object	4%
Optical Illusion/visual misperception	4%
Air Traffic Services	4%
Spatial Disorientation/somatogravic illusion	2%
Lack of visual reference	2%
Terrain/Obstacles	2%
MEL Item	2%
Dispatch/Paperwork	2%
Primary Flight Controls	2%
Structural Failure	2%
Flight Controls	2%
Inad overrun area/trench/ditch/prox of structures	2%

North America Aircraft Accidents



UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Vertical/Lateral/Speed Deviation	20%
Long/floated/bounced/firm/off-center/crabbed landing	17%
Unstable Approach	13%
Abrupt Aircraft Control	11%
Continued Landing after Unstable Approach	11%
Unnecessary Weather Penetration	9%
Operation Outside Aircraft Limitations	9%
Flight Controls/Automation	4%
Brakes/Thrust Reversers/Ground Spoilers	4%
Loss of aircraft control while on the ground	2%
Wrong taxiway/ramp/gate/hold spot	2%
Controlled Flight Toward Terrain	2%
Rejected Takeoff after V_1	2%
Engine	2%

COUNTERMEASURES

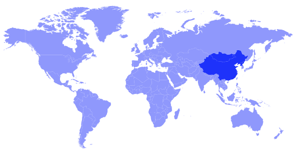
	Percentage Contribution
Monitor/Cross-check	15%
Overall Crew Performance	15%
Captain should show leadership	13%
Leadership	13%
In-flight decision-making/contingency management	11%
Workload Management	7%
Evaluation of Plans	7%
Taxiway/Runway Management	6%
FO is assertive when necessary	6%
Automation Management	6%
Communication Environment	4%

Note: five accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum C

Top Contributing Factors – Section 5

North Asia Aircraft Accidents



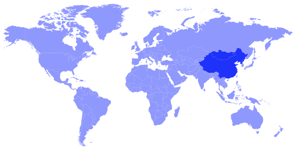
LATENT CONDITIONS

	Percentage Contribution
Flight Ops: Training Systems	57%
Flight Operations	57%
Flight Ops: SOPs & Checking	29%
Selection Systems	29%
Change Management	14%
Ops Planning & Scheduling	14%
Regulatory Oversight	14%
Safety Management	14%
Management Decisions	14%

THREATS

	Percentage Contribution
Wind/Wind shear/Gusty wind	71%
Meteorology	71%
Thunderstorms	43%
Aircraft Malfunction	29%
Airport Facilities	14%
Ground Events	14%
Poor visibility/IMC	14%
Fire/Smoke (Cockpit/Cabin/Cargo)	14%
Contaminated runway/taxiway - poor braking action	14%
Operational Pressure	14%

North Asia Aircraft Accidents



FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	86%
SOP Adherence/SOP Cross-verification	43%
Pilot-to-Pilot Communication	29%
Normal Checklist	14%
Abnormal Checklist	14%
Automation	14%

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Vertical/Lateral/Speed Deviation	71%
Abrupt Aircraft Control	57%
Unstable Approach	43%
Operation Outside Aircraft Limitations	43%
Long/floated/bounced/firm/off-center/crabbed landing	43%
Engine	29%
Unnecessary Weather Penetration	29%
Continued Landing after Unstable Approach	29%
Loss of aircraft control while on the ground	14%
Flight Controls/Automation	14%

COUNTERMEASURES

	Percentage Contribution
Monitor/Cross-check	57%
Overall Crew Performance	57%
Workload Management	43%
Captain should show leadership	14%
In-flight decision-making/contingency management	14%
Communication Environment	14%
Evaluation of Plans	14%
Leadership	14%
Automation Management	14%

Note: one accident was not classified due to insufficient data; this accident was subtracted from the total accident count in the calculation of contributing factor frequency.

Top Contributing Factors – Section 6

Cargo Aircraft Accidents

LATENT CONDITIONS

	Percentage Contribution
Regulatory Oversight	35%
Safety Management	35%
Flight Operations	25%
Flight Ops: SOPs & Checking	20%
Selection Systems	15%
Management Decisions	10%
Flight Ops: Training Systems	10%
Maintenance Operations	10%
Maintenance Ops: SOPs & Checking	10%
Dispatch	5%
Technology & Equipment	5%
Design	5%
Ground Operations	3%
Dispatch Ops: SOPs & Checking	3%
Ops Planning & Scheduling	3%
Ground Ops: Training Systems	3%
Ground Ops: SOPs & Checking	3%

FLIGHT CREW ERRORS

	Percentage Contribution
Manual Handling/Flight Controls	40%
SOP Adherence/SOP Cross-verification	38%
Callouts	13%
Pilot-to-Pilot Communication	8%
Abnormal Checklist	5%
Automation	5%
Briefings	3%
Failure to GOA after abnormal runway contact	3%
Systems/Radios/Instruments	3%
Normal Checklist	3%

Cargo Aircraft Accidents

THREATS

	Percentage Contribution
Meteorology	45%
Aircraft Malfunction	33%
Wind/Wind shear/Gusty wind	28%
Airport Facilities	20%
Poor visibility/IMC	18%
Lack of visual reference	15%
Fatigue	15%
Gear/Tire	13%
Maintenance Events	10%
Operational Pressure	10%
Thunderstorms	8%
Poor/faint marking/signs or runway/taxiway closure	8%
Contained Engine Failure/Powerplant Malfunction	8%
Airport perimeter control/fencing/wildlife control	5%
Wildlife/Birds/Foreign Object	5%
Nav Aids	5%
Inad overrun area/trench/ditch/prox of structures	5%
Air Traffic Services	5%
Ground-based nav aid malfunction or not available	5%
Contaminated runway/taxiway - poor braking action	5%
Spatial Disorientation/somatogravic illusion	3%
Brakes	3%
Terrain/Obstacles	3%
Dispatch/Paperwork	3%
Structural Failure	3%
Ground Events	3%
Optical Illusion/visual misperception	3%
Extensive/Uncontained Engine Failure	3%
Avionics/Flight Instruments	3%

Cargo Aircraft Accidents

UNDESIRED AIRCRAFT STATE

	Percentage Contribution
Vertical/Lateral/Speed Deviation	28%
Long/floated/bounced/firm/off-center/crabbed landing	23%
Unstable Approach	20%
Continued Landing after Unstable Approach	20%
Abrupt Aircraft Control	15%
Unnecessary Weather Penetration	15%
Operation Outside Aircraft Limitations	13%
Brakes/Thrust Reversers/Ground Spoilers	8%
Controlled Flight Toward Terrain	8%
Engine	8%
Rejected Takeoff after V_1	5%
Flight Controls/Automation	5%
Landing Gear	3%
Weight & Balance	3%
Loss of aircraft control while on the ground	3%

COUNTERMEASURES

	Percentage Contribution
Overall Crew Performance	28%
Monitor/Cross-check	28%
In-flight decision-making/contingency management	20%
Leadership	15%
Captain should show leadership	15%
Automation Management	10%
FO is assertive when necessary	10%
Taxiway/Runway Management	5%
Workload Management	5%
Evaluation of Plans	5%

Note: eight accidents were not classified due to insufficient data; these accidents were subtracted from the total accident count in the calculation of contributing factor frequency.

Addendum E

Fatality Risk

Definition

In 2015, IATA added another measure of air carrier safety to its annual Safety Report: **fatality risk.** This measure seeks to answer the following question: what was the exposure of a passenger or crewmember to a catastrophic accident, where all people on board perished?

The equation to calculate the fatality risk is **Q = V/N**, where:

- **N** is the number of flights or sectors conducted during the period
- **V** is the total number of "full-loss equivalents" among the N flights or sectors

The full-loss equivalent for a given flight is the proportion of passengers and crew who do not survive an accident. For example:

- If a flight lands safely, the full-loss equivalent is zero.
- If a flight results in an accident in which all passengers and crew are killed, the full-loss equivalent is one.
- If a flight results in an accident in which half of passengers and crew are killed, the full-loss equivalent is 0.5.

V is the sum of all full-loss equivalents calculated for all N flights. In other words, the fatality risk rate (Q) is the sum of the individual accident full-loss equivalents divided by the total number of flights.

Examples

The following tables illustrate two examples:

Case 1: There were a total of four accidents during the period:

Accident	% of People-Onboard Who Perished	Full-Loss Equivalent
#1	0%	0
#2	100%	1
#3	50%	0.5
#4	50%	0.5
Total Full-Loss Equivalent		2
Number of Sectors		3,000,000
Fatality Risk		0.00000067
Fatality Risk (normalized per 1 million sectors)		0.67

In Case 1, there were a total of four accidents out of three million sectors. Of these four accidents, one had no fatalities, one was a complete hull loss with all on board killed, and two in which half on board perished. In total, there were two full-loss equivalents out of three million sectors, which equates to 0.67 full-loss equivalents per million sectors. In other words, the exposure of all passengers and crew who flew on those sectors to a catastrophic accident was 1 in 1.5 million flights.

Fatality Risk (cont'd)

Case 2: There were a total of six accidents:

Accident	% of People Onboard Who Perished	Full-Loss Equivalent
#1	0%	0
#2	10%	0.1
#3	20%	0.2
#4	50%	0.5
#5	30%	0.3
#6	40%	0.4
Total Full-Loss Equivalent		1.5
Number of Sectors		3,000,000
Fatality Risk		0.0000005
Fatality Risk (normalized per 1 million sectors)		0.50

In Case 2, there were a total of six accidents out of three million sectors. Of these six accidents, five experienced some fatalities, but there was no complete full loss. The total of the full-loss equivalents was 1.5. This equates to a fatality risk of 0.50 per million sectors. The exposure, in this case, was of one catastrophic accident per two million flights.

When comparing the above cases, the risk of perishing on a randomly selected flight is lower in Case 2 even though there were more accidents with fatalities. Case 1 had fewer fatal accidents, but they were more severe. Therefore, the odds of a passenger or crew losing their life on a given flight (fatality risk) is higher in Case 1 than in Case 2.

Considerations

It is important to note that the calculation of fatality risk does not consider the size of the airplane, how many people were on board, or the length of the flight. Rather, what is key is the percentage of people, from the total carried, who perished. It does not consider whether the accident was on a long-haul flight on a large aircraft where 25% of the passengers did not survive, or on a small commuter flight with the same ratio. The likelihood of perishing is the same.

Fatality risk, or full-loss equivalent, can easily be mistaken to represent the number of fatal accidents (or the fatal accident rate). Although fatality risk only exists once there is a fatal accident, they are not the same. While a fatal accident indicates an accident where at least one person perished, the full-loss equivalent indicates the proportion of people on board who perished.

Fatality risk provides a good baseline for comparison between accident categories. For example, Loss of Control – In-flight (LOC-I) is known to have a high fatality risk, but a low frequency of occurrence. Runway Excursion, on the other hand, has a low fatality risk, but a high frequency of occurrence. It is possible, therefore, for the Runway Excursion category to have the same fatality risk as LOC-I if its frequency of occurrence is high enough so that the generally small full-loss equivalent for each individual accident produces the same total full-loss equivalent number as LOC-I (per million sectors).

Finally, as seen throughout the report, the aviation industry is reaching a point where the fatality risk and the fatal accident rate are converging. Much work has been done in improving aviation safety worldwide and, in most cases, the fatal accident rate has been declining over the years. The convergence of fatality risk and fatal accident rate may indicate, although it is not possible to confirm, that the accident prevention efforts have been effective in mitigating the causes of most accidents. Even as accident rates reach historic lows, the work of safety professionals across the commercial aviation industry continues to be as important today as it was in the past.

Addendum F

STEADES Analysis Disclaimer

The information contained in Section 7 - Cabin Safety and in Section 9 – STEADES Analysis of this publication is subject to constant review in the light of changing government requirements and regulations. No subscriber or other reader should act on the basis of any such information without referring to applicable laws and regulations and/or without taking appropriate professional advice. Although every effort has been made to ensure accuracy, the International Air Transport Association (IATA) shall not be held responsible for any loss or damage caused by errors, omissions, misprints or misinterpretation of the contents hereof.

Furthermore, IATA expressly disclaims any and all liability to any person or entity, whether a purchaser of this publication or not, in respect of anything done or omitted, and the consequences of anything done or omitted, by any such person or entity in reliance on the contents of this publication.

The analyses are conducted on Air Safety Reports (ASR) and Cabin Safety Reports (CSR) held in IATA's Safety Trend Evaluation, Analysis & Data Exchange System (STEADES) database. The STEADES database is comprised of de-identified safety incident reports from over 200 participating airlines throughout the world, with an annual reporting rate now exceeding 200,000 reports/year. The STEADES database incorporates a number of quality control processes that assure analysis results.

ASR and CSR data to STEADES is a dynamic process. Data can vary from one quarter to the next, meaning that not all participants' data is incorporated each quarter. This can be due to a participant not submitting data (due to a technical problem) or IATA not incorporating the submitted data (due to data format technical issues or data not meeting IATA's data quality standards). IATA accounts for this in the calculation of sectors (number of flights) to ensure that rate-based information is meaningful, and IATA uses other quality processes to recover missing data. Due to these factors, rate-based comparisons are preferable to a comparison of the number of reports. The reader should also be mindful that the data and rates presented in this report are based on events reported by flight and cabin crew and, therefore, influenced by airline reporting cultures. The analyses cannot confirm if events associated with the categories analyzed were solicited equally among all participating airlines nor if such events were reported routinely or underreported by flight crew.

Annex 1 – Definitions

Abnormal Disembarkation: Passengers and/or crew exit the aircraft via boarding doors (normally assisted by internal aircraft or exterior stairs) after an aircraft incident or accident and when away from the boarding gates or aircraft stands (e.g., onto a runway or taxiway); only in a non-life-threatening and non-catastrophic event.

Accident: IATA defines an accident as an event where ALL of the following criteria are satisfied:

- Person(s) have boarded the aircraft with the intention of flight (either flight crew or passengers).
- The intention of the flight is limited to normal commercial aviation activities, specifically scheduled/charter passenger or cargo service. Executive jet operations, training, and maintenance/test flights are excluded.
- The aircraft is turbine-powered and has a certificated Maximum Takeoff Weight (MTOW) of at least 5,700 kg (12,540 lbs).
- The aircraft has sustained major structural damage that adversely affects the structural strength, performance or flight characteristics of the aircraft and would normally require major repair or replacement of the affected component exceeding $1 million USD or 10% of the aircraft's hull reserve value, whichever is lower, or the aircraft has been declared a hull loss.

Accident Classification: Process by which actions, omissions, events, conditions, or a combination thereof, that led to an accident are identified and categorized.

Aircraft: Involved aircraft, used interchangeably with airplane(s).

Cabin Safety-related Event: Accident involving cabin operational issues (e.g., passenger evacuation, onboard fire, decompression, ditching) that requires actions by the operating cabin crew.

Captain: Involved pilot responsible for the operation and safety of the aircraft during flight time.

Commander: Involved pilot, in an augmented crew, responsible for the operation and safety of the aircraft during flight time.

Crew member: Anyone on board a flight who has duties connected with the sector of the flight during which the accident happened. It excludes positioning or relief crew, security staff, etc. (see definition of "Passenger" below).

Evacuation (Land): Passengers and/or crew evacuate the aircraft via escape slides/slide rafts, doors, emergency exits or gaps in the fuselage (usually initiated in life-threatening and/or catastrophic events).

Evacuation (Water): Passengers and/or crew evacuate the aircraft via escape slides/slide rafts, doors, emergency exits or gaps in the fuselage and into or onto water.

Fatal Accident: Accident where at least one passenger or crew member is killed or later dies of their injuries, resulting from an operational accident. Events such as slips, trips and falls, food poisoning, or injuries resulting from turbulence or involving onboard equipment, which may involve fatalities, but where the aircraft sustains minor or no damage, are excluded.

Fatality: Passenger or crew member who is killed or later dies of their injuries resulting from an operational accident. Injured persons who die more than 30 days after an accident are excluded.

Fatality Risk: Sum of full-loss equivalents per 1 million sectors, measuring the exposure of a passenger or crew member to a non-survivable accident. A full-loss equivalent is related to the percentage of people onboard who perished. Please refer to Addendum E for additional information.

Full-Loss Equivalent: Number representing the equivalent of a catastrophic accident where all people onboard died. For an individual accident, the full-loss equivalent is a value between 0 and 1, representing the ratio between the number of people who perished and the number of people on board the aircraft. In a broader context, the full-loss equivalent is the sum of each accident's full-loss equivalent value. Please refer to Addendum E for additional information.

Hazard: Condition, object or activity with the potential of causing injuries to persons, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function.

Hull Loss: Accident in which the aircraft is destroyed or substantially damaged and is not subsequently repaired for whatever reason, including a financial decision of the owner.

Hull Loss/Nil Survivors: Accident resulting in a complete hull loss with no survivors (used as a Cabin End State).

IATA Accident Classification System: Refer to Annexes 2 and 3 of this report.

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. For a complete list of countries assigned per region, please consult the following table:

IATA REGIONS

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

Region	Country
	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
	Vietnam

Region	Country
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
	Israel
	Kosovo
	Latvia
	Liechtenstein
	Lithuania
	Luxembourg
	Macedonia, the former Yugoslav Republic of
	Malta
	Monaco

Region	Country
	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
	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

Region	Country
	Saint Vincent and the Grenadines
	Suriname
	Trinidad and Tobago
	Uruguay
	Venezuela
MENA	Afghanistan
	Algeria
	Bahrain
	Egypt
	Iran, Islamic Republic of
	Iraq
	Jordan
	Kuwait
	Lebanon
	Libya
	Morocco
	Oman
	Palestinian Territories
	Qatar
	Saudi Arabia
	Sudan
	Syrian Arab Republic
	Tunisia
	United Arab Emirates
	Yemen
NAM	Canada
	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

Incident: Occurrence, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of operation.

In-flight Security Personnel: Individual who is trained, authorized and armed by the State and is carried on board an aircraft and whose intention is to prevent acts of unlawful interference.

Investigation: Process conducted for accident prevention, which includes the gathering and analysis of information, the drawing of conclusions (including the determination of causes) and, when appropriate, the making of safety recommendations.

Investigator in Charge: Person charged, based on his or her qualifications, with the responsibility for the organization, conduct and control of an investigation.

Involved: Directly concerned, or designated to be concerned, with an accident or incident.

Level of Safety: How far safety is to be pursued in a given context, assessed with reference to an acceptable risk, based on the current values of society.

Major Repair: A repair that, if improperly done, might appreciably affect the mass, balance, structural strength, performance, power plant operation, flight characteristics, or other qualities affecting the airworthiness of an aircraft.

Non-operational Accident: Includes accidents resulting from acts of deliberate violence (e.g., sabotage, war) and accidents that occur during crew training, demonstrations and test flights. Violence is believed to be a matter of security rather than flight safety. Crew training, demonstrations and test flights are considered to involve special risks inherent with these types of operations. Also included in this category are:

- Non-airline-operated aircraft (e.g., military or government-operated, survey, aerial work or parachuting flights).
- Accidents where there was no intention of flight.

Normal Disembarkation: Passengers and/or crew exit the aircraft via boarding doors during normal operations.

Occurrence: Any unusual or abnormal event involving an aircraft, including, but not limited to, an incident.

Operational Accident: Accident that is believed to represent the risks of normal commercial operation; generally an accident that occurs during normal revenue operations or a positioning flight.

Operator: Person, organization or enterprise engaged in, or offering to engage in, aircraft operations.

Passenger: Anyone on board a flight who, as far as may be determined, is not a crewmember. Apart from normal revenue passengers, this includes off-duty staff members, positioning and relief flight crew members, etc., who have no duties connected with the sector of the flight during which the accident happened. Security personnel are included as passengers as their duties are not concerned with the operation of the flight.

Person: Any involved individual, including airport and Air Traffic Service (ATS) personnel.

Phase of Flight: The phase of flight definitions developed and applied by IATA are presented in the table on the following page.

Rapid Deplaning: Passengers and/or crew rapidly exit the aircraft via boarding doors and a jet bridge or stairs, as a precautionary measure.

Risk: Assessment, expressed in terms of predicted probability and severity, of the consequence(s) of a hazard, taking as reference the worst foreseeable situation.

Safety: State in which the risk of harm to persons or property is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and risk management.

Sector: Operation of an aircraft between takeoff at one location and landing at another (other than a diversion).

Serious Injury: Injury sustained by a person in an accident and which meets one of the following:

- Requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received.
- Results in a fracture of any bone (except simple fractures of fingers, toes or nose).
- Involves lacerations that cause severe hemorrhage or nerve, muscle or tendon damage.
- Involves injury to any internal organ.
- Involves second or third-degree burns, or any burns affecting more than 5% of the surface of the body.
- Involves verified exposure to infectious substances or injurious radiation.

Serious Incident: Incident involving circumstances indicating that an accident nearly occurred. *Note:* the difference between an accident and a serious incident lies only in the result.

Substantial Damage: Damage or structural failure, which adversely affects the structural strength, performance or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected component.

Notes:

- Bent fairing or cowling, dented skin, small punctured holes in the skin or fabric, minor damage to landing gear, wheels, tires, flaps, engine accessories, brakes, or wing tips are not considered "substantial damage" for the purpose of this Safety Report.
- The ICAO Annex 13 definition is unrelated to cost and includes many incidents in which the financial consequences are minimal.

Unmanned Aircraft System: Defined by ICAO as an aircraft and its associated elements that are operated without a pilot on board.

Unstable Approach: Approach where the IATA ACTG has knowledge about vertical, lateral or speed deviations in the portion of the flight close to landing. *Note:* this definition includes the portion immediately prior to touchdown and in this respect the definition might differ from other organizations. However, accident analysis gives evidence that a destabilization just prior to touchdown has contributed to accidents in the past.

PHASE OF FLIGHT DEFINITIONS

Flight Planning (FLP) This phase begins when the flight crew initiates the use of flight planning information facilities and becomes dedicated to a flight based upon a route and airplane; it ends when the crew arrives at the aircraft for the planned flight or the crew initiates a 'Flight Close' phase.

Preflight (PRF) This phase begins with the arrival of the flight crew at an aircraft for the flight; it ends when a decision is made to depart the parking position and/or start the engine(s). It may also end by the crew initiating a 'Post-flight' phase. *Note:* the Preflight phase assumes the aircraft is sitting at the point at which the aircraft will be loaded or boarded, with the primary engine(s) not operating. If boarding occurs during this phase, it is done without any engine(s) operating. Boarding with any engine(s) operating is covered under 'Engine Start/Depart'.

Engine Start/Depart (ESD) This phase begins when the flight crew take action to have the aircraft moved from the parked position and/or take switch action to energize the engine(s); it ends when the aircraft begins to move under its own power or the crew initiates an 'Arrival/Engine Shutdown' phase. *Note:* the Engine Start/Depart phase includes the aircraft engine(s) start-up whether assisted or not and whether the aircraft is stationary with more than one engine shutdown prior to 'Taxi-out' (i.e., boarding of persons or baggage with engines running); it includes all actions of power back to position the aircraft for Taxi-out.

Taxi-out (TXO) This phase begins when the crew moves the aircraft forward under its own power; it ends when thrust is increased for 'Takeoff' or the crew initiates a 'Taxi-in' phase. *Note:* this phase includes taxi from the point of moving under the aircraft's own power, up to and including entering the runway and reaching the Takeoff position.

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.

Rejected Takeoff (RTO) This phase begins when the crew reduces thrust to stop the aircraft before the end of the Takeoff phase; it ends when the aircraft is taxied off the runway for a 'Taxi-in' phase or when the aircraft is stopped and engines shutdown.

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.

Taxi-in (TXI) This phase begins when the crew begins to maneuver the aircraft under its own power to an arrival area for parking; it ends when the aircraft ceases moving under its own power with a commitment to shut down the engine(s). It may also end by the crew initiating a 'Taxi-out' phase.

Arrival/Engine Shutdown (AES) This phase begins when the crew ceases to move the aircraft under its own power and a commitment is made to shut down the engine(s); it ends with a decision to shut down ancillary systems to secure the aircraft. It may also end by the crew initiating an 'Engine Start/Depart' phase. *Note:* the Arrival/Engine Shutdown phase includes actions required during a time when the aircraft is stationary with one or more engines operating while ground servicing may be taking place (i.e., deplaning persons or baggage with engine(s) running and/or refueling with engine(s) running).

Post-flight (PSF) This phase begins when the crew commences the shutdown of ancillary systems of the aircraft to leave the flight deck; it ends when the flight and cabin crew leave the aircraft. It may also end by the crew initiating a 'Preflight' phase.

Flight Close (FLC) This phase begins when the crew initiates a message to the flight-following authorities that the aircraft is secure and the crew is finished with the duties of the past flight; it ends when the crew has completed these duties or begins to plan for another flight by initiating a 'Flight Planning' phase.

Ground Servicing (GDS) This phase begins when the aircraft is stopped and available to be safely approached by ground personnel for the purpose of securing the aircraft and performing the duties applicable to the arrival of the aircraft (i.e., aircraft maintenance); it ends with completion of the duties applicable to the departure of the aircraft or when the aircraft is no longer safe to approach for the purpose of ground servicing (e.g., prior to crew initiating the 'Taxi-out' phase). *Note:* the GDS phase was identified by the need for information that may not directly require the input of flight or cabin crew. It is acknowledged as an entity to allow placement of the tasks required of personnel assigned to service the aircraft.

Annex 2
Accident Classification Taxonomy

1. LATENT CONDITIONS

Definition: Conditions present in the system before the accident and triggered by various possible factors.

Latent Conditions (deficiencies in...)	Examples
Design	↗ Design shortcomings ↗ Manufacturing defects
Regulatory Oversight	↗ Deficient regulatory oversight by the State or lack thereof
Management Decisions	↗ Cost cutting ↗ Stringent fuel policy ↗ Outsourcing and other decisions, which can impact operational safety
Safety Management	Absent or deficient: ↗ Safety policy and objectives ↗ Safety risk management (including hazard identification process) ↗ Safety assurance (including Quality Management) ↗ Safety promotion
Change Management	↗ Deficiencies in monitoring change; in addressing operational needs created by, for example, expansion or downsizing ↗ Deficiencies in the evaluation to integrate and/or monitor changes to establish organizational practices or procedures ↗ Consequences of mergers or acquisitions
Selection Systems	↗ Deficient or absent selection standards
Operations Planning and Scheduling	↗ Deficiencies in crew rostering and staffing practices ↗ Issues with flight and duty time limitations ↗ Health and welfare issues
Technology and Equipment	↗ Available safety equipment not installed (EGPWS, predictive wind shear, TCAS/ACAS, etc.)

1. LATENT CONDITIONS (CONT'D)

Flight Operations	See the following breakdown
Flight Operations: Standard Operating Procedures and Checking	↗ Deficient or absent: 1. Standard Operating Procedures (SOPs) 2. Operational instructions and/or policies 3. Company regulations 4. Controls to assess compliance with regulations and SOPs
Flight Operations: Training Systems	↗ Omitted training, language skills deficiencies, qualifications and experience of flight crews, operational needs leading to training reductions, deficiencies in assessment of training or training resources such as manuals or CBT devices
Cabin Operations	See the following breakdown
Cabin Operations: Standard Operating Procedures and Checking	↗ Deficient or absent: 1. SOPs 2. Operational instructions and/or policies 3. Company regulations 4. Controls to assess compliance with regulations and SOPs
Cabin Operations: Training Systems	↗ Omitted training, language skills deficiencies, qualifications and experience of cabin crews, operational needs leading to training reductions, deficiencies in assessment of training or training resources such as manuals or CBT devices
Ground Operations	See the following breakdown
Ground Operations: SOPs and Checking	↗ Deficient or absent: 1. SOPs 2. Operational instructions and/or policies 3. Company regulations 4. Controls to assess compliance with regulations and SOPs
Ground Operations: Training Systems	↗ Omitted training, language skills deficiencies, qualifications and experience of ground crews, operational needs leading to training reductions, deficiencies in assessment of training or training resources such as manuals or CBT devices

1. LATENT CONDITIONS (CONT'D)

Maintenance Operations	See the following breakdown
Maintenance Operations: SOPs and Checking	↗ Deficient or absent: 1. SOPs 2. Operational instructions and/or policies 3. Company regulations 4. Controls to assess compliance with regulations and SOPs ↗ Includes deficiencies in technical documentation, unrecorded maintenance and the use of bogus parts/unapproved modifications
Maintenance Operations: Training Systems	↗ Omitted training, language skills deficiencies, qualifications and experience of maintenance crews, operational needs leading to training reductions, deficiencies in assessment of training or training resources such as manuals or CBT devices
Dispatch	See the following breakdown
Dispatch: Standard Operating Procedures and Checking	↗ Deficient or absent: 1. SOPs 2. Operational instructions and/or policies 3. Company regulations 4. Controls to assess compliance with regulations and SOPs
Dispatch: Training Systems	↗ Omitted training, language skills deficiencies, qualifications and experience of dispatchers, operational needs leading to training reductions, deficiencies in assessment of training or training resources such as manuals or CBT devices
Flight Watch	↗ Flight Watch/ Flight Following
Other	↗ Not clearly falling within the other latent conditions

Note: All areas such as Training, Ground Operations or Maintenance include outsourced functions for which the operator has oversight responsibility.

2. THREATS

Definition: 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.

Mismanaged threat: A threat that is linked to or induces a flight crew error.

Environmental Threats	Examples
Meteorology	See the following breakdown
	↗ Thunderstorms
	↗ Poor visibility/Instrument Meteorological Conditions (IMC)
	↗ Wind/wind shear/gusty wind
	↗ Icing conditions
	↗ Hail
Lack of visual reference	↗ Darkness/black hole effect ↗ Environmental situation, which can lead to spatial disorientation
Air Traffic Services	↗ Tough-to-meet clearances/restrictions ↗ Reroutes ↗ Language difficulties ↗ Controller errors ↗ Failure to provide separation (air/ground)
Wildlife/ Birds/Foreign Objects	↗ Self-explanatory
Airport Facilities	See the following breakdown
	↗ Poor signage, faint markings ↗ Runway/taxiway closures
	↗ Contaminated runways/taxiways ↗ Poor braking action
	↗ Trenches/ditches ↗ Inadequate overrun area ↗ Structures in close proximity to runway/taxiway
	↗ Inadequate airport perimeter control/fencing ↗ Inadequate wildlife control

2. THREATS (CONT'D)

Navigational Aids	See the following breakdown
	↗ Ground navigation aid malfunction ↗ Lack or unavailability (e.g., Instrument Landing System)
	↗ NAV aids not calibrated – unknown to flight crew
Terrain/Obstacles	↗ Self-explanatory
Traffic	↗ Aircraft striking other aircraft (e.g., during runway incursion) ↗ Ground vehicles hitting aircraft
Runway Surface Incursion	↗ Aircraft ↗ Vehicle ↗ Wildlife ↗ Other
Other	↗ Not clearly falling within the other environmental threats
Airline Threats	Examples
Aircraft Malfunction	See breakdown (on the next page)
MEL Item	↗ Minimum Equipment List (MEL) items with operational implications
Operational Pressure	↗ Operational time pressure ↗ Missed approach/diversion ↗ Other non-normal operations
Cabin Events	↗ Cabin events (e.g., unruly passenger) ↗ Cabin crew errors ↗ Distractions/interruptions
Ground Events	↗ Aircraft loading events ↗ Fueling errors ↗ Agent interruptions ↗ Improper ground support ↗ Improper deicing/anti-icing
Dispatch/Paperwork	↗ Load sheet errors ↗ Crew scheduling events ↗ Late paperwork changes or errors
Maintenance Events	↗ Aircraft repairs on ground ↗ Maintenance log problems ↗ Maintenance errors
Dangerous Goods	↗ Carriage of articles or substances capable of posing a significant risk to health, safety or property when transported by air
Manuals/ Charts/Checklists	↗ Incorrect/unclear chart pages or operating manuals ↗ Checklist layout/design issues
Other	↗ Not clearly falling within the other airline threats

2. THREATS (CONT'D)

Aircraft Malfunction Breakdown (Technical Threats)	Examples
Extensive/Uncontained Engine Failure	↗ Damage due to non-containment
Contained Engine Failure / Power plant Malfunction	↗ Engine overheat ↗ Propeller failure ↗ Failure affecting power plant components
Gear/Tire	↗ Failure affecting parking, taxi, takeoff or landing
Brakes	↗ Failure affecting parking, taxi, takeoff or landing
Flight Controls	See the following breakdown
Primary Flight Controls	↗ Failure affecting aircraft controllability
Secondary Flight Controls	↗ Failure affecting flaps, spoilers
Structural Failure	↗ Failure due to flutter, overload ↗ Corrosion/fatigue ↗ Engine separation
Fire/Smoke in Cockpit/Cabin/Cargo	↗ Fire due to aircraft systems ↗ Other fire causes
Avionics, Flight Instruments	↗ All avionics except autopilot and the Flight Management System (FMS) ↗ Instrumentation, including standby instruments
Autopilot/FMS	↗ Self-explanatory
Hydraulic System Failure	↗ Self-explanatory
Electrical Power Generation Failure	↗ Loss of all electrical power, including battery power
Other	↗ Not clearly falling within the other aircraft malfunction threats

3. FLIGHT CREW ERRORS

Definition: An observed flight crew deviation from organizational expectations or crew intentions.
Mismanaged error: An error that is linked to or induces additional error or an undesired aircraft state.

Aircraft Handling Errors	Examples
Manual Handling/Flight Controls	↗ Hand flying vertical, lateral, or speed deviations ↗ Approach deviations by choice (e.g., flying below the glide slope) ↗ Missed runway/taxiway, failure to hold short, taxi above speed limit ↗ Incorrect flaps, speed brake, autobrake, thrust reverser or power settings
Ground Navigation	↗ Attempting to turn down wrong taxiway/runway ↗ Missed taxiway/runway/gate
Automation	↗ Incorrect altitude, speed, heading, autothrottle settings, mode executed, or entries
Systems/ Radios/Instruments	↗ Incorrect packs, altimeter, fuel switch settings, or radio frequency dialed
Other	↗ Not clearly falling within the other errors
Procedural Errors	Examples
Standard Operating Procedures Adherence / Standard Operating Procedures Cross-verification	↗ Intentional or unintentional failure to cross-verify (automation) inputs ↗ Intentional or unintentional failure to follow SOPs ↗ Pilot flying makes own automation changes ↗ Sterile cockpit violations
Checklist	See the following breakdown
Normal Checklist	↗ Checklist performed from memory or omitted ↗ Wrong challenge and response ↗ Checklist performed late or at wrong time ↗ Checklist items missed
Abnormal Checklist	↗ Checklist performed from memory or omitted ↗ Wrong challenge and response ↗ Checklist performed late or at wrong time ↗ Checklist items missed
Callouts	↗ Omitted takeoff, descent, or approach callouts
Briefings	↗ Omitted departure, takeoff, approach, or handover briefing; items missed ↗ Briefing does not address expected situation

3. FLIGHT CREW ERRORS (CONT'D)

Documentation	See the following breakdown
	↗ Wrong weight and balance information, wrong fuel information
	↗ Wrong Automatic Terminal Information Service (ATIS), or clearance recorded
	↗ Misinterpreted items on paperwork
	↗ Incorrect or missing log book entries
Failure to Go Around	↗ Failure to go around after destabilization on approach ↗ Failure to go around after a bounced landing
Other Procedural	↗ Administrative duties performed after top of descent or before leaving active runway ↗ Incorrect application of MEL
Communication Errors	Examples
Crew to External Communication	See breakdown
With Air Traffic Control	↗ Flight crew to ATC – missed calls, misinterpretation of instructions, or incorrect read-backs ↗ Wrong clearance, taxiway, gate or runway communicated
With Cabin Crew	↗ Errors in Flight to Cabin Crew communication ↗ Lack of communication
With Ground Crew	↗ Errors in Flight to Ground Crew communication ↗ Lack of communication
With Dispatch	↗ Errors in Flight Crew to Dispatch communication ↗ Lack of communication
With Maintenance	↗ Errors in Flight to Maintenance Crew communication ↗ Lack of communication
Pilot-to-Pilot Communication	↗ Within Flight Crew miscommunication ↗ Misinterpretation ↗ Lack of communication

4. UNDESIRED AIRCRAFT STATES (UAS)

Definition: 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**.

Mismanaged UAS: A UAS that is linked to or induces additional flight crew errors.

Undesired Aircraft States	Breakdown
Aircraft Handling	↗ Abrupt aircraft control
	↗ Vertical, lateral or speed deviations
	↗ Unnecessary weather penetration
	↗ Unauthorized airspace penetration
	↗ Operation outside aircraft limitations
	↗ Unstable approach
	↗ Continued landing after unstable approach
	↗ Long, floated, bounced, firm, porpoised, off-center landing ↗ Landing with excessive crab angle
	↗ Rejected takeoff after V1
	↗ Controlled flight toward terrain
	↗ Other
Ground Navigation	↗ Proceeding toward wrong taxiway/runway
	↗ Wrong taxiway, ramp, gate or hold spot
	↗ Runway/taxiway incursion
	↗ Ramp movements, including when under marshalling
	↗ Loss of aircraft control while on the ground
	↗ Other

4. UNDESIRED AIRCRAFT STATES (UAS) (CONT'D)

Incorrect Aircraft Configurations	↗ Brakes, thrust reversers, ground spoilers
	↗ Systems (fuel, electrical, hydraulics, pneumatics, air conditioning, pressurization/ instrumentation)
	↗ Landing gear
	↗ Flight controls/automation
	↗ Engine
	↗ Weight & balance
	↗ Other

5. END STATES

Definition: An end state is a reportable event. It is **unrecoverable**.

End States	Definitions
Controlled Flight into Terrain	↗ In-flight collision with terrain, water, or obstacle without indication of loss of control
Loss of Control – In-flight	↗ Loss of aircraft control while in flight
Runway Collision	↗ Any occurrence at an airport involving the incorrect presence of an aircraft, vehicle, person or wildlife on the protected area of a surface designated for the landing and takeoff of aircraft and resulting in a collision
Mid-Air Collision	↗ Collision between aircraft in flight
Runway/Taxiway Excursion	↗ A Veer off or overrun off the runway or taxiway surface
In-flight Damage	Damage occurring while airborne, including: ↗ Weather-related events, technical failures, bird strikes and fire/smoke/fumes
Ground Damage	Damage occurring while on the ground, including: ↗ Occurrences during (or as a result of) ground handling operations ↗ Collision while taxiing to or from a runway in use (excluding a runway collision) ↗ Foreign object damage ↗ Fire/smoke/fumes

5. END STATES (CONT'D)

Undershoot	↗ A touchdown off the runway surface
Hard Landing	↗ Any hard landing resulting in substantial damage
Gear-up Landing/ Gear Collapse	↗ Any gear-up landing/collapse resulting in substantial damage (without a runway excursion)
Tail Strike	↗ Tail strike resulting in substantial damage
Off-Airport Landing/ Ditching	↗ Any controlled landing outside of the airport area

6. FLIGHT CREW COUNTERMEASURES

The following list includes countermeasures that the flight crew can take. Countermeasures from other areas, such as ATC, ground operations personnel and maintenance staff, are not considered at this time.

Team Climate		
Countermeasure	Definition	Example Performance
Communication Environment	Environment for open communication is established and maintained	Good cross-talk – flow of information is fluid, clear, and direct No social or cultural disharmonies; right amount of hierarchy gradient Flight crew member reacts to assertive callout of other crew member(s)
Leadership	See the following breakdown	
	Captain should show leadership and coordinate flight deck activities	In command, decisive, and encourages crew participation
	First Officer (FO) is assertive when necessary and is able to take over as the leader	FO speaks up and raises concerns
Overall Crew Performance	Overall, crew members should perform well as risk managers	Includes Flight, Cabin, Ground crew as well as their interactions with ATC
Other	Not clearly falling within the other categories	

6. FLIGHT CREW COUNTERMEASURES (CONT'D)

Planning		
SOP Briefing	The required briefing should be interactive and operationally thorough	Concise and not rushed – bottom lines are established
Plans Stated	Operational plans and decisions should be communicated and acknowledged	Shared understanding about plans – "Everybody on the same page"
Contingency Management	Crew members should develop effective strategies to manage threats to safety: ▪ Proactive: In-flight decision-making ▪ Reactive: Contingency management	↗ Threats and their consequences are anticipated ↗ Use all available resources to manage threats
Other	Not clearly falling within the other categories	
Execution		
Monitor/ Cross-check	Crew members should actively monitor and cross-check flight path, aircraft performance, systems and other crew members	Aircraft position, settings, and crew actions are verified
Workload Management	Operational tasks should be prioritized and properly managed to handle primary flight duties	↗ Avoid task fixation ↗ Do not allow work overload
Automation Management	Automation should be properly managed to balance situational and/or workload requirements	↗ Brief automation setup ↗ Effective recovery techniques from anomalies
Taxiway/Runway Management	Crew members use caution and keep watch outside when navigating taxiways and runways	Clearances are verbalized and understood – airport and taxiway charts or aircraft cockpit moving map displays are used when needed
Other	Not clearly falling within the other categories	
Review/Modify		
Evaluation of Plans	Existing plans should be reviewed and modified when necessary	Crew decisions and actions are openly analyzed to make sure the existing plan is the best plan
Inquiry	Crew members should not be afraid to ask questions to investigate and/or clarify current plans of action	"Nothing taken for granted" attitude – crew members speak up without hesitation
Other	Not clearly falling within the other categories	

7. ADDITIONAL CLASSIFICATIONS

Additional Classification	Breakdown
Insufficient Data	Accident does not contain sufficient data to be classified
Incapacitation	Crew member unable to perform duties due to physical or psychological impairment
Fatigue	Crew member unable to perform duties due to fatigue
Spatial Disorientation and Spatial/ Somatogravic Illusion (SGI)	SGI is a form of spatial disorientation that occurs when a shift in the resultant gravitoinertial force vector created by a sustained linear acceleration is misinterpreted as a change in pitch or bank attitude

IATA Training

BE AWARE!
GET READY!

ICAO Global Reporting Format applicable as of 5th November 2020!

Runway excursions remain one of the top challenges to aviation, with serious impacts in terms of safety and cost.

The assessment and reporting of Runway Surface Conditions (RSC) are being addressed by ICAO through the implementation of a revised Global Reporting Format (GRF). This methodology for harmonized and global implementation, will be applicable from 5th November 2020.

In a joint effort between IATA and ICAO, we developed an e-learning course to assist flight crew, dispatchers and operational staff to understand and use the new Runway Condition reporting requirements as outlined in ICAO Circular 355 (Assessment, Measurement and Reporting of Runway Surface Conditions) and ICAO Doc 10064 (Aeroplane Performance Manual [APM]).

Upon completing this course, you will have the skills to:

- Explain the need and fundamental requirements for a harmonized GRF for Runway Condition Assessment and Reporting
- Summarize the end-to-end process of a Runway Condition Assessment and Reporting
- Describe the factors which require adjustments to braking and acceleration performance to account for runway conditions
- Use a Runway Condition Report (RCR) to assess takeoff and landing performance

For more information, please visit

iata.org/training-talp38

Annex 3 – Accidents Summary

DATE	MANUFAC-TURER	AIRCRAFT	REGIS-TRATION	OPERATOR	LOCATION	PHASE	SERVICE	PROPUL-SION	SEVERITY	SUMMARY
19-01-21	Boeing	B737-300	9S-AHJ	Serve Air	Kinshasa - N`Djili Int'l, DR Congo	LND	Freighter	Jet	Substantial Damage	Left-hand main landing gear collapse upon landing
19-01-23	De Havilland (Bombardier)	Dash-8-100/200	C-GTCO	Air Creebec	Rouyn, Quebec, Canada	TOF	Passenger	Turboprop	Substantial Damage	Runway excursion during takeoff
19-01-26	ATR	ATR 72	VT-AIX	Alliance Air		LND	Passenger	Turboprop	Substantial Damage	Tail strike on landing
19-01-28	Boeing	B727-200	N720CK	Kalitta Charters II	Tuscaloosa - Van De Graaf Regional, AL, USA	LND	Freighter	Jet	Substantial Damage	Nose gear collapse on landing
19-01-29	Airbus	A321	VT-PPN	Air India	Tirupati, India	TOF	Passenger	Jet	Substantial Damage	FOD damage during departure
19-02-08	Airbus	A321	SE-RKA	Novair	Billund, Denmark	LND	Passenger	Jet	Substantial Damage	Hard landing and tail strike
19-02-16	Boeing	B737-800	PK-LPS	Lion Air	Pontianak - Supadio, Indonesia	LND	Passenger	Jet	Substantial Damage	Runway overrun on landing
19-02-23	Boeing	B767-300	N1217A	Atlas Air	Houston - Intercontinental, TX, USA	APR	Freighter	Jet	Hull Loss	The aircraft was on approach and crashed
19-02-26	Embraer	ERJ135	ZS-SJX	Airlink	Kasane	ICL	Passenger	Jet	Substantial Damage	Bird strike during initial climb
19-03-04	Embraer	ERJ145	N14171	CommutAir	Presque Isle, ME, USA	LND	Passenger	Jet	Substantial Damage	Runway excursion, hard landing and gear collapse
19-03-10	Boeing	B737 MAX 8	ET-AVJ	Ethiopian Airlines	Addis Ababa - Bole International, Ethiopia	ICL	Passenger	Jet	Hull Loss	The aircraft crashed after departure
19-03-10	Airbus	A380-800	F-HPJC	Air France	En Route	ECL	Passenger	Jet	Substantial Damage	The aircraft suffered a contained engine failure while climbing
19-03-19	Fokker	100	EP-IDG	Iran Air	Tehran - Mehrabad International, Iran	DST	Passenger	Jet	Substantial Damage	Gear-up landing due to main gear failed to extend
19-04-08	BAE Systems	BAE Jetstream 41	HI1038	Sky High	Roseau - Melville Hall, Dominica	LND	Passenger	Turboprop	Substantial Damage	Runway excursion on landing
19-04-10	Airbus	A321	N114NN	American Airlines	New York/John F. Kennedy International, NY.	TOF	Passenger	Jet	Substantial Damage	Wingtip strike and collision with runway sign during takeoff
19-04-23	Airbus	A320	AP-EDA	Airblue	Peshawar/Intl.	LND	Passenger	Jet	Substantial Damage	Runway excursion on landing

DATE	MANUFAC-TURER	AIRCRAFT	REGIS-TRATION	OPERATOR	LOCATION	PHASE	SERVICE	PROPUL-SION	SEVERITY	SUMMARY
19-05-03	Boeing	B737-800	N732MA	Miami Air International	Jacksonville - NAS Jacksonville, FL, USA	LND	Passenger	Jet	Substantial Damage	Runway overrun on landing, aircraft ends up in river
19-05-05	Sukhoi	Superjet 100-95	RA-89098	Aeroflot Russian Airlines	Moscow - Sheremetyevo, Russia	LND	Passenger	Jet	Hull Loss	The aircraft burst into flames during rollout and burns up
19-05-08	De Havilland (Bombardier)	Dash 8-400	S2-AGQ	Biman Bangladesh Airlines	Yangon International	LND	Passenger	Turboprop	Hull Loss	The aircraft veered off the runaway, with gear collapsed and fuselage broken into three sections
19-05-10	De Havilland (Bombardier)	Dash-8-300	C-FJXZ	Jazz	Toronto/Lester B. Pearson Intl, ON	TXI	Passenger	Turboprop	Substantial Damage	Fuel truck ran into aircraft
19-06-09	Boeing	B737-900	N75436	United Airlines	Denver International	LND	Passenger	Jet	Substantial Damage	Tail strike on landing
19-06-15	Boeing	B757-200	N26123	United Airlines	Newark - Liberty International, NJ, USA	LND	Passenger	Jet	Substantial Damage	The aircraft bounced and touched down hard causing damage to the nose gear and forward fuselage
19-06-15	ATR	ATR 42-300	PR-MPN	MAP Linhas Aereas	Manaus - Eduardo Gomes International, Brazil	LND	Passenger	Turboprop	Substantial Damage	Gear-up landing after emergency return
19-06-17	Boeing	B737-800	N8608N	Southwest Airlines	Pittsburgh/ Pittsburgh International, PA.	PRF	Passenger	Jet	Substantial Damage	Aircraft struck by a catering vehicle
19-06-27	BAE Systems	BAE Jetstream 31	YV2536	Transmandu - Transportes Aereos Manduca	Canaima, Bolivar	LND	Passenger	Turboprop	Hull Loss	Runway excursion, aircraft caught fire
19-06-27	Antonov	An-24	RA-47366	Angara Airlines	Nizhneangarsk Airport	LND	Passenger	Turboprop	Hull Loss	The aircraft suffered an engine failure, then it veered off the runway and collided with building
19-07-01	Boeing	B737 (CFMI)	VT-SYK	SpiceJet	Mumbai - Chhatrapati Shivaji International, India	LND	Passenger	Jet	Substantial Damage	The aircraft overran the runway on landing
19-07-12	ATR	ATR 72	9N-AMM	Yeti Airlines	Kathmandu - Tribhuvan International, Nepal	LND	Passenger	Turboprop	Substantial Damage	Runway excursion on landing
19-07-12	ATR	ATR 42-300	SX-FOR	Sky Express	Naxos	TXO	Passenger	Turboprop	Substantial Damage	Runway excursion on backtrack for departure
19-07-19	De Havilland (Bombardier)	Dash 8-400	C-FKWE	WestJet Encore	Edmonton - International, Alberta, Canada	LND	Passenger	Turboprop	Substantial Damage	Abonormal runway contact
19-07-20	ATR	ATR 42-300	AP-BHP	Pakistan International Airlines	Gilgit, Pakistan	LND	Passenger	Turboprop	Substantial Damage	The aircraft suffered a runway excursion on landing
19-07-23	Boeing	B737-300	5N-BQO	Air Peace	Lagos - Murtala Muhammed, Nigeria	LND	Passenger	Jet	Substantial Damage	Hard landing caused nose wheels to separate

DATE	MANUFAC-TURER	AIRCRAFT	REGIS-TRATION	OPERATOR	LOCATION	PHASE	SERVICE	PROPUL-SION	SEVERITY	SUMMARY
19-07-30	Airbus	A319	D-AILR	Lufthansa	Frankfurt/Main	PRF	Passenger	Jet	Substantial Damage	Collision between aircraft and another staircase towed by motor vehicle
19-08-07	BAE Systems	BAE Jetstream 31	HK-4540	SARPA	Bahia Solano - Jose Celestino Mutis, Colombia	LND	Passenger	Turboprop	Substantial Damage	Veer off upon landing
19-08-08	Airbus	A321	N717FR	Frontier Airlines	Orlando - International, FL, USA	LND	Passenger	Jet	Substantial Damage	Wind shear causes hard landing and tail strike
19-08-15	Airbus	A321	VQ-BOZ	Ural Airlines	Zhukovsky, Russia	ICL	Passenger	Jet	Hull Loss	Bird strike into both engines forces landing in corn field
19-08-16	De Havilland (Bombardier)	Dash-8-100/200	5Y-SLM	SafariLink Aviation	Kichwa Tembo, Masai Mara, Kenya	LND	Passenger	Turboprop	Substantial Damage	The aircraft suffered left-hand landing gear failure after striking several wildebeest on landing
19-08-18	Boeing	B757-200	N543US	Delta Air Lines	Ponta Delgada, Azores	LND	Passenger	Jet	Substantial Damage	The aircraft suffered a hard landing
19-08-27	Airbus	A330-300	B-5958	Air China	Beijing - Capital, China	PRF	Passenger	Jet	Hull Loss	Aircraft on fire at the gate
19-09-03	Airbus	A330-300	VQ-BMY	Aeroflot Russian Airlines	Moscow/ Sheremetyevo	ESD	Passenger	Jet	Substantial Damage	Ground collision
19-09-07	ATR	ATR 72	HK-5041	Regional Express Americas	Manizales/Caldas	LND	Passenger	Turboprop	Substantial Damage	The aircraft suffered a tail strike on landing
19-10-04	Antonov	An-12	UR-CAH	Ukraine Air Alliance	L'viv	APR	Freighter	Turboprop	Hull Loss	The aircaft ran out of fuel
19-10-11	Fokker	50	5Y-IZO	Silverstone Air Services	Nairobi/Wilson	RTO	Passenger	Turboprop	Substantial Damage	The aircraft overran runway after aborting takeoff
19-10-17	Saab	Saab 2000	N686PA	Penair	Unalaska,AK.	LND	Passenger	Turboprop	Substantial Damage	The aircraft overran runway on landing
19-11-11	Embraer	ERJ145	N619AE	Envoy Air	Chicago - O'hare International, IL.	LND	Passenger	Jet	Substantial Damage	The aircraft suffered a runway excursion on landing
19-11-21	Boeing	B737-800	TC-JGZ	Turkish Airlines	Odesa	LND	Passenger	Jet	Substantial Damage	Runway excursion and nose gear collapse on landing
19-11-22	Boeing	B737-400	YV3012	Avior Airlines	Bogota Intl/ Cundinamarca	LND	Passenger	Jet	Substantial Damage	Right main gear collapse during roll out
19-11-24	Fairchild Dornier	Dornier 228	9S-GNH	Busy Bee Congo	Goma	TOF	Passenger	Turboprop	Hull Loss	The aircraft crashed shortly after takeoff and impacted populated area past departure runway
19-11-25	De Havilland (Bombardier)	Dash-8-300	9J-PZB	Proflight Zambia	Kakumbi	DST	Passenger	Turboprop	Substantial Damage	Lightning and hail strike, downdraft, severe turbulence
19-12-03	Boeing (Douglas)	BT-67	C-FKAL	North Star Air Cargo	Sachigo Lake, ON	APR	Freighter	Turboprop	Substantial Damage	Aircraft impacted ground during approach

DATE	MANUFAC-TURER	AIRCRAFT	REGIS-TRATION	OPERATOR	LOCATION	PHASE	SERVICE	PROPUL-SION	SEVERITY	SUMMARY
19-12-10	De Havilland (Bombardier)	Dash 8-400	ET-AQC	Ethiopian Airlines	Juba	TOF	Passenger	Turboprop	Substantial Damage	The aircraft overran the runway on takeoff
19-12-22	Boeing	B737-800	N87513	United Airlines	Denver International	LND	Passenger	Jet	Substantial Damage	Main gear collapse on landing
19-12-27	Fokker	100	UP-F1007	Bek Air	Almaty	TOF	Passenger	Jet	Hull Loss	The aircraft lost height shortly after takeoff and impacted building after two tailstrikes

Annex 4 – Table of Sectors

This table provides a breakdown of the sectors used in the production of rates for this report by aircraft type and year.
It is up-to-date as at the time of report production.

MANUFACTURER	MODEL	2015	2016	2017	2018	2019
Airbus	A300	143,485	144,683	144,205	152,439	160,061
Airbus	A310	43,018	33,672	24,291	23,823	22,036
Airbus	A318	97,842	91,665	94,673	103,619	108,800
Airbus	A319	2,306,185	2,281,543	2,215,512	2,228,237	2,339,649
Airbus	A320	6,204,016	6,669,403	6,823,019	6,986,449	7,335,771
Airbus	A321	1,542,421	1,834,125	2,130,165	2,303,342	2,418,509
Airbus	A330	976,326	1,014,361	1,073,681	1,138,552	1,195,480
Airbus	A340	128,331	114,831	101,171	99,892	92,400
Airbus	A350	5,009	31,738	114,356	223,144	234,301
Airbus	A380	89,214	107,284	118,311	126,195	132,505
Aircraft Industries (LET)	410	121,400	118,875	115,331	96,881	89,615
Antonov	An-12	3,676	3,485	4,574	4,846	5,088
Antonov	An-124	5,909	6,477	7,210	7,266	7,629
Antonov	An-140	864	555	552	663	696
Antonov	An-148	20,638	22,188	25,506	19,710	18,232
Antonov	An-158	8,573	10,729	6,920	1,208	1,117
Antonov	An-22	-	33	76	77	81
Antonov	An-225	48	48	48	38	35
Antonov	An-24	32,415	31,858	28,478	31,248	32,810
Antonov	An-26	19,102	19,981	20,528	20,425	18,893
Antonov	An-28	3,725	3,512	3,195	2,693	2,491
Antonov	An-3	692	697	695	546	505
Antonov	An-30	860	782	780	516	477
Antonov	An-32	5,122	4,754	5,428	4,407	4,076
Antonov	An-38	1,600	1,584	977	526	487
Antonov	An-72 / An-74	3,373	3,318	3,306	3,457	3,630

MANUFACTURER	MODEL	2015	2016	2017	2018	2019
ATR	ATR 42	313,383	328,012	345,593	354,108	371,813
ATR	ATR 72	1,172,052	1,286,489	2,107,233	2,820,435	2,961,457
Avro	RJ100	149,402	140,214	110,119	105,014	97,138
BAE Systems	146	45,300	37,519	42,599	40,841	37,778
BAE Systems	ATP	27,288	20,055	19,816	-	-
BAE Systems	Jetstream 31	249,877	223,443	212,402	224,332	235,549
BAE Systems	Jetstream 41	72,516	65,614	75,713	81,966	86,064
BAE Systems (Hawker Siddeley)	748	11,448	11,586	11,160	10,551	9,760
Boeing	717	264,908	296,841	296,152	306,355	321,673
Boeing	727	36,665	32,790	28,359	23,554	21,787
Boeing	737	9,425,968	10,045,969	10,821,381	12,085,135	12,689,392
Boeing	747	324,932	306,252	320,886	299,743	277,262
Boeing	757	594,873	554,719	561,654	620,969	652,017
Boeing	767	663,517	707,923	887,704	808,834	748,171
Boeing	777	929,188	1,004,147	1,076,998	1,063,132	983,397
Boeing	787	207,211	293,411	387,184	474,344	498,061
Boeing (Douglas)	DC-10	40,596	35,098	31,252	28,255	26,136
Boeing (Douglas)	DC-3	9,466	10,077	9,306	9,296	8,599
Boeing (Douglas)	DC-8	455	205	233	186	172
Boeing (Douglas)	DC-9	32,095	32,499	30,067	30,115	31,621
Boeing (Douglas)	MD-11	80,662	75,972	74,935	76,246	80,058
Boeing (Douglas)	MD-80	589,616	582,682	581,174	501,442	463,834
Boeing (Douglas)	MD-90	109,502	103,160	92,784	83,923	77,629
Bombardier	C Series	-	2,761	31,496	397,739	417,626
Canadair (Bombardier)	CRJ	2,222,927	2,277,215	2,259,712	2,374,499	2,493,224
Canadair (Bombardier)	CL-415	2,864	2,871	2,866	2,864	2,649
CASA / IAe	212	30,523	33,089	31,972	32,343	33,960
CASA / IAe	235	7,090	7,102	7,092	7,090	6,558
Comac	ARJ21	233	3,275	5,745	13,957	14,655
Convair	580	36,194	32,130	27,606	27,429	25,372
Convair	640	4,943	4,883	4,601	4,961	5,209

MANUFACTURER	MODEL	2015	2016	2017	2018	2019
De Havilland (Bombardier)	DHC-6	807,489	834,320	833,945	855,121	897,877
De Havilland (Bombardier)	DHC-7	35,836	23,995	21,040	27,983	29,382
De Havilland (Bombardier)	DHC-8	1,603,448	1,829,595	1,699,214	1,679,555	1,553,588
De Havilland (Bombardier)	DHC-5	1,084	986	-	282	296
Embraer	110 Bandeirante	56,582	57,464	55,456	57,752	60,640
Embraer	120 Brasilia	93,477	87,661	85,267	145,995	153,295
Embraer	135	221,310	226,347	204,854	201,677	186,551
Embraer	140	40,591	31,140	16,185	83,110	87,266
Embraer	145	821,456	721,520	687,586	820,027	861,028
Embraer	170	321,732	293,214	277,377	209,970	194,222
Embraer	175	476,608	626,154	760,991	566,546	524,055
Embraer	190	917,167	874,052	942,551	964,769	1,013,007
Embraer	195	245,287	274,794	292,013	301,311	316,377
Evektor EV-55 Outback	EV55	-	-	-	3,302	3,467
Fairchild (Swearingen)	Metro	737,233	727,050	685,390	672,121	621,712
Fairchild Dornier	228	179,860	180,409	183,591	187,682	197,066
Fairchild Dornier	328	61,899	60,867	56,386	64,695	67,930
Fairchild Dornier	328JET	55,419	53,572	53,624	48,068	44,463
Fokker	100	156,617	136,843	125,055	119,911	110,918
Fokker	50	64,422	70,025	128,347	187,218	196,579
Fokker	70	54,868	48,010	53,285	39,884	36,893
Fokker	F27	4,015	3,184	3,571	4,058	4,261
Fokker	F28	357	357	357	357	330
Gippsland Aeronautics	N22B / N24A Nomad	420	446	446	447	469
Grumman	G73 Turbo Mallard	5,945	5,966	5,946	5,945	5,499
Gulfstream Aerospace (Grumman)	G-I	4,754	4,531	4,489	4,488	4,151
Harbin	Y12	16,732	16,317	17,263	18,655	19,588
Hawker Beechcraft	1900	985,125	947,560	908,600	896,551	829,310
Hawker Beechcraft	C99	204,464	201,472	198,735	197,497	182,685
Ilyushin	Il-114	1,108	1,110	1,107	364	337
Ilyushin	Il-18	2,036	2,282	1,930	3,276	3,440

MANUFACTURER	MODEL	2015	2016	2017	2018	2019
Ilyushin	Il-62	2,199	2,284	2,479	2,658	2,791
Ilyushin	Il-76	19,267	18,061	18,417	19,022	19,973
Ilyushin	Il-96	3,859	4,209	4,165	5,020	5,271
Lockheed Martin	L-182 / L-282 / L-382 (L-100) Hercules	25,594	24,572	23,983	23,172	21,434
NAMC	YS-11	3,721	3,452	4,276	3,876	3,585
Saab	2000	52,346	44,927	45,851	34,492	31,905
Saab	340	283,438	270,087	283,453	289,218	303,679
Shorts	330	9,767	5,869	4,152	5,872	6,166
Shorts	360	55,906	57,620	59,162	59,857	62,850
Shorts	Skyvan (SC-7)	8,755	8,253	8,003	7,358	6,806
Sukhoi	Superjet 100	61,979	86,552	109,465	151,743	159,330
Tupolev	Tu-134	14,066	12,469	10,916	9,039	8,361
Tupolev	Tu-154	13,193	10,023	6,435	8,358	8,776
Tupolev	Tu-204 / Tu-214	10,881	9,640	10,570	11,440	12,012
Xian	MA-60	9,531	10,046	11,017	11,396	11,966
Yakovlev	Yak-40	23,637	22,766	23,080	25,304	26,569
Yakovlev	Yak-42 / Yak-142	19,933	16,129	13,291	12,769	11,811

Source: Ascend - A Flightglobal Advisory Service

LIST OF ACRONYMS/ABBREVIATIONS

Accident Category Abbreviation

Abbreviation	Full Name
CFIT	Controlled Flight into Terrain
G UP LDG/CLPSE	Gear-up Landing/Gear Collapse
GND DAMAGE	Ground Damage
HARD LDG	Hard Landing
IN-F DAMAGE	In-Flight Damage
LOC-I	Loss of Control – In-flight
MID-AIR COLL	Mid-Air Collision
OFF AIRP LDG	Off-Airport Landing
OTHER	Other End State
RWY COLL	Runway Collision
RWY/TWY EXC	Runway/Taxiway Excursion
TAILSTRIKE	Tail Strike
UNDERSHOOT	Undershoot

List of Acronyms

Acronym	Meaning
A/C	Aircraft
AAPA	Association of Asia Pacific Airlines
ACAS	Airborne Collision Avoidance System
ACDM	Airport Collaborative Decision Making
ACS	Aviation Cyber Security
ACSR	Aviation Cyber Security Roundtable
ACSTF	Aviation Cyber Security Task Force
ACTG	Accident Classification Technical Group
ADX	Accident Data Exchange
AFI	Africa
AFRAA	African Airlines Association
AHM	Airport Handling Manual
AIG	Accident Investigation Group
ALAR	Approach and Landing Accidents

List of Acronyms (Cont'd)

Acronym	Meaning
ALTA	Asociación Latinoamericana y del Caribe de Transporte Aéreo
AMC	Aviation Meteorological Center
AMDAR	Aircraft Meteorological Data Relay
ANSPs	Air Navigation Service Providers
AOC	Air Operator Certificate
AOV	Areas of Vulnerability
APAC	Asia-Pacific
APRAST	Asia-Pacific Regional Aviation Safety Team
ARC	Abnormal Runway Contact
ASIAS	Aviation Safety Information Analysis and Sharing
ASPAC	Asia-Pacific
ASR	Annual Safety Report
ASR	Air Safety Report
ASRT	Annual Safety Report Team
ATC	Air Traffic Control
ATFM	Air Traffic Flow Management
ATIS	Automatic Terminal Information System
ATM	Air Traffic Management
ATMB	Air Traffic Management Bureau
ATOs	Approved Training Organizations
ATS	Air Traffic Services
AUPRTA	Airplane Upset Prevention and Recovery Training Aid
AVSEC	Aviation Security
AZANS	Azerbaijan Air Navigation Service Provider
BIRD	Bird Strike
CAAC	Civil Aviation Administration of China
CAAs	Civil Aviation Authorities
CAAS	Civil Aviation Authority of Singapore
CABIN	Cabin Safety Events
CANSO	Civil Air Navigation Services Organization
CAST	Commercial Aviation Safety Team
CBT	Competence-based Training
CBTA	Competency-based Training and Assessment
CBTA-TF	Competency-based Training and Assessment Task Force
CEDAR	Connected, Ecological, Digital, Automated Ramp
CFIT	Controlled Flight into Terrain
CICTT	CAST/ICAO Common Taxonomy Team

List of Acronyms (Cont'd)

Acronym	Meaning
CIS	Commonwealth of Independent States
CMA	Continuous Monitoring Approach
CoPA	Charter of Professional Auditors
COSTG	Cabin Operations Safety Technical Group
CPDLC	Controller Pilot Data Link Communicator
CRM	Crew Resource Management
CSR	Cabin Safety Report
CST	Collaborative Safety Teams
CTOL	Collision with obstacle(s) during takeoff and landing
DAQCP	De-Icing/Anti-Icing Quality Control Pool
DTAC	Digital Transformation Advisory Council
EASA	European Aviation Safety Agency
EASPG	European Regional Aviation System Planning Group
EBT	Evidence-based Training
EGPWS	Enhanced Ground Proximity Warning System
EI	Effective Implementation
ERP	Emergency Response Planning
ERPWG	Emergency Response Planning Working Group
ESI	Emerging Safety Concerns
EU	European Union
EUR	Europe Region
F-NI	Fire/Smoke - non-impact
FAA	Federal Aviation Administration (of the USA)
FDM	Flight Data Monitoring
FDX	Flight Data eXchange
FLE	Full-Loss Equivalents
FLTOPSP-CSSG	Flight Operations Panel Cargo Safety Subgroup
FMA	Flight Modes Annunciator
FMS	Flight Management System
FO	First Officer
FOD	Foreign Object Debris
FOPs	Flight Operations
FOQA	Flight Operations Quality Assurance
FRMS	Fatigue Risk Management System
FSO	Fundamentals of Safety Oversight
FSTD	Flight Simulation Training Devices
G-COL	Ground Collision

List of Acronyms (Cont'd)

Acronym	Meaning
GADM	Global Aviation Data Management
GASP	Global Aviation Safety Plan
GDDB	Ground Damage Database
GNSS	Global Navigation Satellite System
GOG	Ground Operations Group
GPS	Global Positioning System
GRF	Global Reporting Format
GRSAP	Global Runway Safety Action Plan
GS	Ground Safety
GSE	Ground Support Equipment
GSIE	Global Safety Information Exchange
GSPs	Ground Service Providers
HKCAD	Hong Kong Civil Aviation Department
I-ASC	IATA Aviation Safety Culture
IAC	Interstate Aviation Committee
IATA	International Air Transport Association
IATF	IATA Airline Training Fund
ICAO	International Civil Aviation Organization
IDQP	IATA Drinking Water Quality Pool
IDX	Incident Data Exchange
IE-REST	ICAO European Regional Expert Safety Team
IEs	Instructors and Evaluators
IFALPA	International Federation of Air Line Pilots' Association
IFATCA	International Federation of Air Traffic Controllers' Associations
IFQP	IATA Fuel Quality Pool
IGOM	IATA Ground Operations Manual
IIT	ISSA Implementation Training
ILS	Instrument Landing Systems
IMC	Instrument Meteorological Conditions
IMX	Integrated Management Solution
IOSA	IATA Operational Safety Audit
ISAGO	IATA Safety Audit for Ground Operations
ISARPs	IATA Standards and Recommended Practices
ISM	IOSA Standards Manual
ISSA	IATA Standard Safety Assessment
ITU	International Telecommunication Union
KPIs	Key Performance Indicators

List of Acronyms (Cont'd)

Acronym	Meaning
LATAM	Latin-America
LATAM/CAR	Latin-America and Caribbean
LOC-G	Loss of Control - Ground
LOC-I	Loss of Control – In-flight
LOSA	Line Operations Safety Audit
LPRI TF	Language Proficiency Requirements Implementation Task Force
MAC	Mid-Air Collision
MANPADS	Man-Portable Air Defense Systems
MED	Injuries to and/or Incapacitation of Persons
MEL	Minimum Equipment List
MENA	Middle East and North Africa
MID	Middle East
MoU	Memorandum of Understanding
MPL	Multi-Crew Pilot License
MTOW	Maximum Takeoff Weight
NAM	North America
NAS	National Airspace Strategy
NASIA	North Asia
NAT	North Atlantic
NOTAM	Notice To Airmen
OD	Operational Damage
OEMs	Original Equipment Manufacturers
OPS	Operations
OTH	Other
PA	Pan-America
PANS-TRG	Procedures for Air Navigation Services - Training
PAT	Pilot Aptitude Testing
PBBs	Passenger Boarding Bridges
PBN	Performance-based Navigation
PFD	Primary Flight Display
RAs	Resolution Advisories
RASG	Regional Aviation Safety Group
RASG-EUR	Regional Aviation Safety Group – Europe
RASG–PA	Regional Aviation Safety Group – Pan-America
RCAM	Runway Condition Assessment Matrix
RCG	Regional Coordinating Group
RCOG	RASG Coordination Group

List of Acronyms (Cont'd)

Acronym	Meaning
RE	Runway Excursion
RPAS	Remotely Piloted Aircraft Systems
RS	Runway Safety
RSAP WG	Runway Safety Action Plan Working Group
RSC	Runway Surface Conditions
RSTs	Runway Safety Teams
RVSM	Reduced Vertical Separation Minimum
SAC	Security Advisory Council
SAT	South Atlantic
SCF-NP	System/Component Failure or Malfunction (Non-Powerplant)
SCF-PP	System/Component Failure or Malfunction (Powerplant)
SEG	Security Group
SEIs	Safety Enhancement Initiatives
SFGOAC	Flight and Ground Operations Advisory Committee
SFO	Safety and Flight Operations
SG	Safety Group
SGHA	Standard Ground Handling Agreement
SGI	Somatogravic Illusion
SIRM	Safety Issue Review Meeting
SLOP	Strategic Lateral Offset Procedure
SM ICG	Safety Management International Collaboration Group
SMP	Safety Management Panel
SMS	Safety Management System
SOPs	Standard Operating Procedure
SPARC	Safety Predictive Analytics Research Center
SPG	Systems Planning Group
SPIs	Safety Performance Indicators
SSCs	Significant Safety Concerns
SSP	State Safety Program
STEADES	Safety Trends Evaluation, Analysis and Data Exchange System
TAs	Traffic Advisories
TAWS	Terrain Awareness Warning System
TCAS	Traffic Alert and Collision Avoidance System
TCO	Third Country Operator
TEM	Threat and Error Management
TMA	Terminal Control Area
TSA	Transport Security Administration

List of Acronyms (Cont'd)

Acronym	Meaning
UAS	Undesired Aircraft State
UAS	Unmanned Aircraft Systems
UNK	Unknown
UPRT	Upset Prevention and Recovery Training
USAP	Universal Security Audit Program
USOAP	Universal Safety Oversight Audit Program
USOS	Undershoot/Overshoot
UTM	Unmanned Traffic Management
WMO	Word Meteorological Organization

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