RASG-PA ANNUAL SAFETY REPORT

Ninth Edition

Information produced with data from 2009 until 2018

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Foreword

The Regional Aviation Safety Group – Pan America (RASG-PA) was established in November 2008 with a vision to remain ahead of any risks to commercial aviation, seeking to achieve the highest level of safety in the Pan American Region, as well as addressing global aviation safety matters from a regional perspective.

RASG-PA membership includes representatives from all States/Territories of the International Civil Aviation Organization (ICAO) North American (NAM), Caribbean (CAR) and South American (SAM) Regions, international organizations and industry. ICAO serves as the group Secretariat, providing administrative, coordination and technical support to the RASG-PA, its working groups, and committees.

The RASG-PA safety management process, as depicted in Figure 1, consists of four recurrent stages. The process begins with the safety data gathering and analysis to produce safety intelligence, allowing for a consolidated vision of the main areas of interest for the development of safety improvement actions, tailored to the realities of the Pan American Region.

Figure 1. RASG-PA Safety Management Process

Previous editions of the Annual Safety Report and other RASG-PA related documentation can be downloaded at: www.icao.int/rasgpa. For additional information contact: rasg-pa@icao.int

Executive Summary

The results of the analysis of regional aviation safety data continue to show that the top categories to focus safety enhancement initiatives (SEIs) remain:

- Loss of Control In-flight (LOC-I)
- Runway Excursion (RE)
- Controlled Flight Into Terrain (CFIT)
- Mid-Air Collision (MAC)

According to the statistics contained in this report, the number of accidents in 2018 in the Pan American Region (ICAO NAM, CAR and SAM) for scheduled commercial air transport operations involving aircraft with maximum take-off mass (MTOM) above 5,700 kilograms was higher than the previous years, however, the accident rate was lower.

The four SEIs continue to show decreasing trends through the latest ten-year period, not only while looking at the reactive data, but also according to the behaviour of their precursors, as described in the predictive safety information section of this report.

The analysis conducted to determine correlations between the critical elements (CEs) of an effective safety oversight system and areas of the ICAO Universal Safety Oversight Audit Programme - Continuous Monitoring Approach (USOAP-CMA), showed that main findings for the Pan American Region were related to CEs 4 (Technical personnel qualification and training), 7 (Surveillance obligations) and 8 (Resolution of safety concerns); in relation to Aerodrome and Ground Aids (AGA) and Air Navigation Services (ANS) areas.

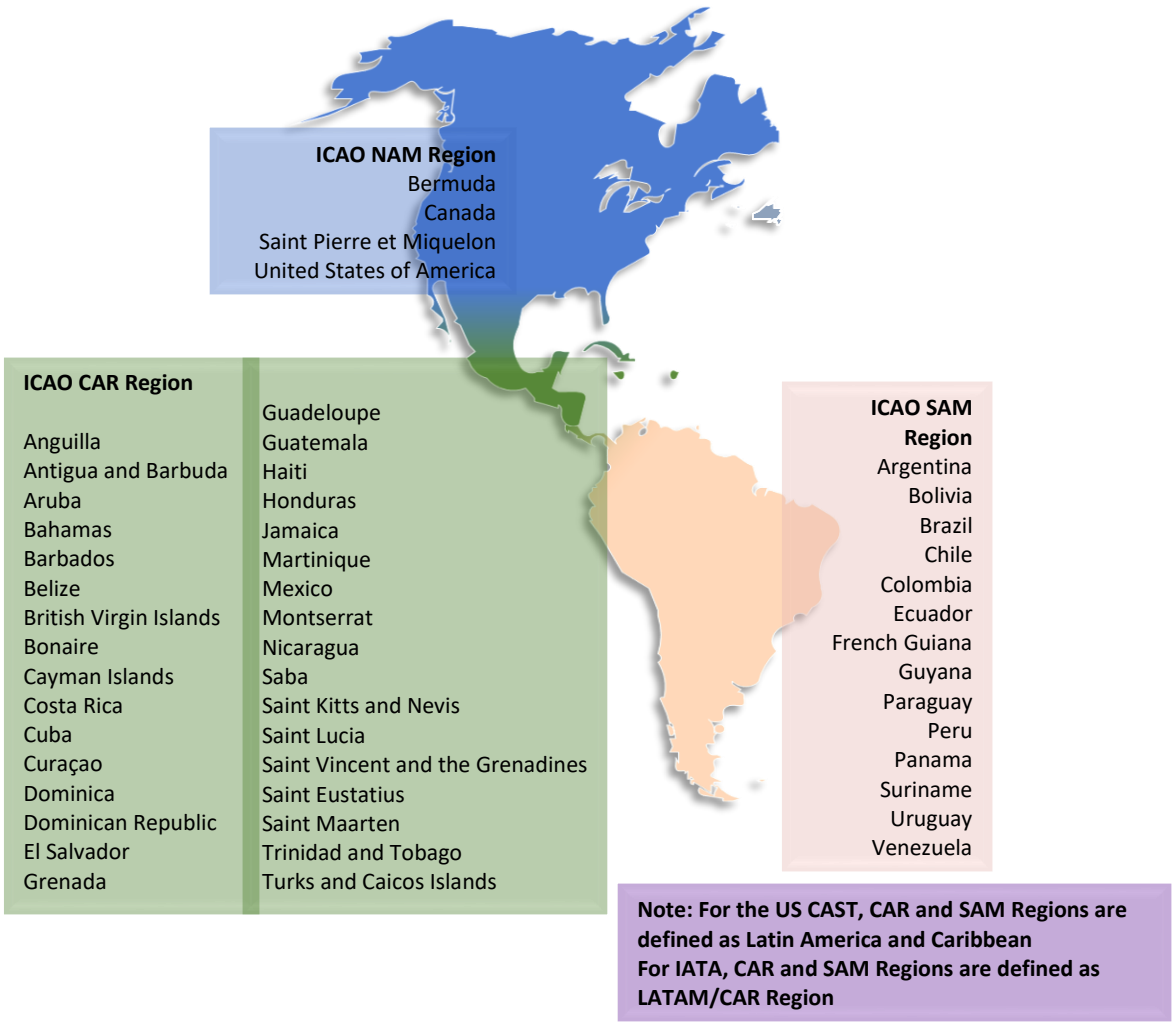
Considering the projected commercial traffic growth for CAR and SAM Regions, proactive analysis also reinforces the necessity to improve ANS and AGA areas, especially in this Regions.

Information on Large Height Deviations (LHDs) registered in the CAR and SAM Regions during 2017 and 2018, shows that the technical error satisfies the goal of not exceeding 2.5×10^{-9} fatal accidents per flight hour due to loss of standard vertical separation of 1,000 ft and all other causes.

About the report

The principal objective for publishing this report is to highlight its usefulness as a safety intelligence tool, by focusing on the main aviation safety areas of interest in the Pan American Region, incorporating an integrated vision from different stakeholders. The improvements in every new edition of the Annual Safety Report are oriented to facilitate the comprehension of the methodologies, data analysis tools, and other information necessary to implement safety management activities, plans and programs to ensure risk mitigation in the aviation sector.

Figure 2. The Pan American Region (RASG-PA Region)



How this report is structured

The report is structured into two parts:

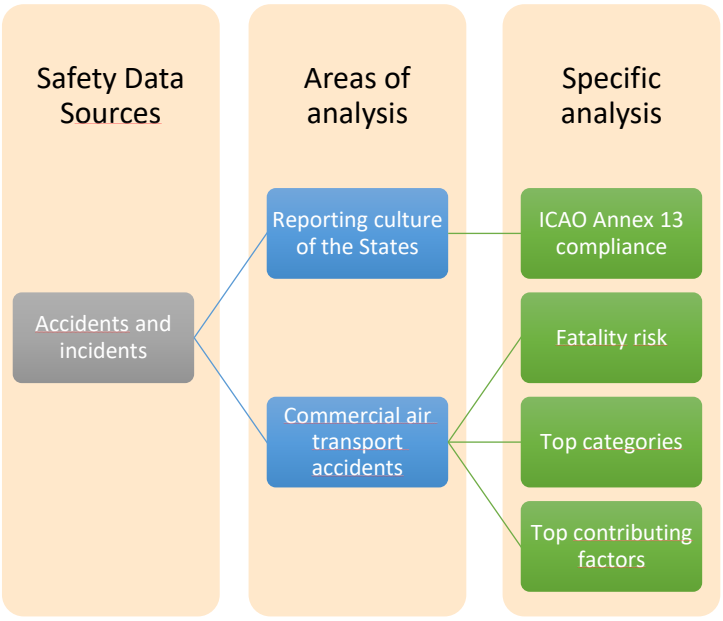
Part One: Safety Information

The first part of the report is oriented to present relevant safety information, according to aviation safety management principles[1], which state that hazards can be identified using three distinct methodologies:

[1] ICAO Annex 19 and Document 9859.

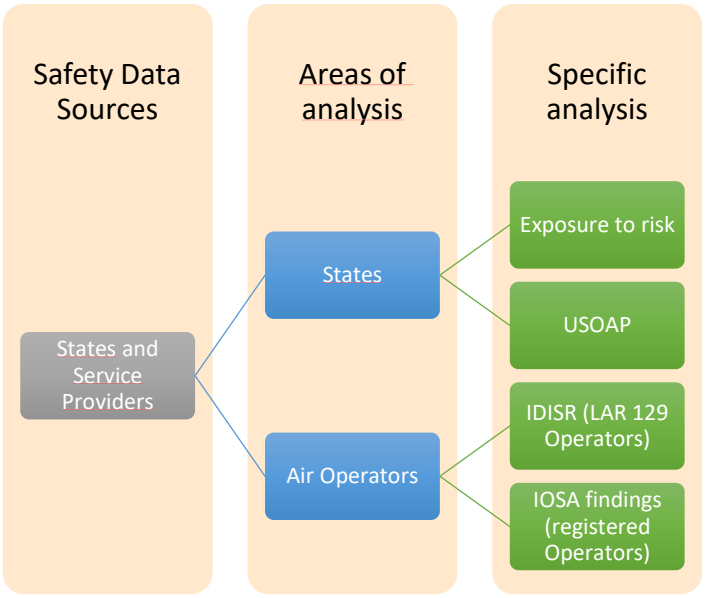
1. **Reactive**: Refers to the analysis of results or past events. Through investigation processes, hazards contributing to accidents or incidents can be identified. In this report, the reactive section presents safety analysis based upon accidents and incidents, as shown in the following figure.

Figure 3. Reactive Safety Data Analysis



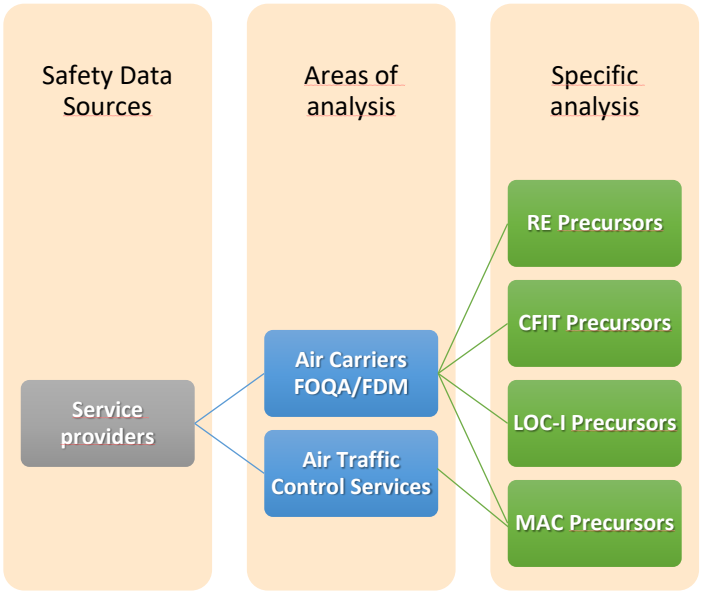
2. **Proactive**: Refers to the analysis of existing conditions. Safety assurance processes, such as audits or evaluations, could provide information on hazards into processes in place. The proactive section of this report includes analysis of audit results for the States' (ICAO Standards and Recommended Practices implementation, traffic) and service providers as IOSA (IATA Operational Safety Audits).

Figure 4. Proactive Safety Data Analysis



3. **Predictive**: oriented to detect possible future negative events, through system processes and contextual data collection and analysis. For this report, the predictive section highlights analysis of de-identified Flight Operations Quality Assurance (FOQA) data, which is oriented to the identification of future hazards in-order to develop corresponding risk mitigation actions.

Figure 5. Predictive Safety Data Analysis



Through this structure, subsequent editions of the report shall reflect the improvements in safety information processing and exchange; by transitioning from almost only reactive information (in earlier editions), to the current balance of the contents on each section.

Part Two: Safety Intelligence

The second part of the report reflects the use of the data analysis results to develop safety intelligence, establishing correlations to facilitate the decision-making process and for the benefit of aviation safety.

Sources of information

Information is only as good as the sources from which it is obtained. To be valid and included in the Annual Safety Report, the information used requires the existence of processes to assure data quality and traceability.

Every stakeholder has a specific approach and uses distinct indicators to measure aviation safety. A goal of the Annual Safety Report is to highlight the main common areas of interest, providing a context in which joint efforts could allow better resources allocation and significant improvement of safety.

Currently, the Annual Safety Report is only possible by the in-kind contribution of the Commercial Aviation Safety Team from United States (US CAST), Boeing, the International Air Transport Association (IATA), ICAO, the Regional Safety Oversight Cooperation System (SRVSOP) and the Caribbean and South America Regional Monitoring Agency (CARSAMMA), who provide the safety information supporting the identification of areas of interest for aviation safety with an integrated

view. Other stakeholders are invited to contribute to aviation safety by providing useful information for the Annual Safety Report, or by participating in the RASG-PA, its work groups and committees.

Interacting with the Annual Safety Report

As mentioned previously, the Annual Safety Report is intended to show the behavior of aviation safety at a regional level, with a consolidated perspective amongst the stakeholders.

Users of the Annual Safety Report are invited to apply the proposed methodology; to establish a starting point or a mechanism to improve safety data management by consolidating relevant information from different sources, and by deepening the analysis of the exposed areas, to be more representative of their specific reality and context.

Part One: Safety information

1. Reactive Safety Information

Using the reactive methodology, this section is intended to assist with comprehending the behavior of Safety in the Pan American Region, based upon the analysis of accidents and incidents, according to the data provided by the US CAST, Boeing, IATA and ICAO.

It is important to note that each stakeholder captures a specific portion of data and develops metrics applicable to particular areas of interest. The Annual Safety Report challenge is to identify and apply the data to allow for a cross-sectional understanding of safety, thus overcoming individual limitations. To develop the metrics in this report, commercial aviation accidents data, gathered and processed by the different stakeholders was considered, according to the following criterions.

- ICAO data on accidents, serious incidents and incidents occurred during scheduled commercial air transport operations, involving aircraft with maximum takeoff mass above 5,700 kg, classified by State of Occurrence. The analyzed time frame was 2009-2018.
- Accidents occurred from 2009 to 2018 resulting in hull losses and/or onboard fatalities involving western built aircraft during part 121 or equivalent operations (greater than 9 seats or greater than 7,500 pounds of cargo capacity), classified by the State of Operator, provided by the US CAST.
- IOSA results and accidents involving fixed-wing aircraft over 5,700 kg with jet or turboprop propulsion engaged in commercial operations, in the time period 2013-2018, provided by IATA.

1.1 Pan American accident statistics and rates

According to ICAO data, 45 accidents during regular commercial air transport operations, involving aircraft above 5,700 kilograms occurred in Pan America, 3 of those accidents resulted in fatalities.

The distribution of 2018 global accidents, fatal accidents and fatalities by RASGs (Regional Aviation Safety Groups) is shown in table 1. Also, table 2 shows the specific numbers for the Pan American Region.

Table 1. Accident Statistics and Accident Rates – 2018

RASG	Estimated Departures (in millions)	Number of accidents	Accident rate (per million departures)	Fatal accidents	Fatalities	Share of Traffic	Share of Accidents
AFI	1 440 702	4	2.8	2	21	3.8%	4.1%
APAC	12 445 017	20	1.6	3	241	32.7%	20.4%
EUR	9 298 706	26	2.8	2	72	24.4%	26.5%
MID	1 326 656	3	2.3	1	66	3.5%	3.1%
PA	13 575 682	45	3.3	3	114	35.6%	45.9%
WORLD	38 086 763	98	2.6	11	514	100%	100%

Table 2. 2009-2018 Scheduled Commercial Air Transport Accidents occurred in Pan America

Year	Total Accidents	Fatal accidents[2]	Total fatalities
2009-2018 avg.	40.5	2.3	37.5
2018	45	3	114
2017	47	1	1

In 2018, both the number of total accidents and total fatalities are higher than the 10-year average.

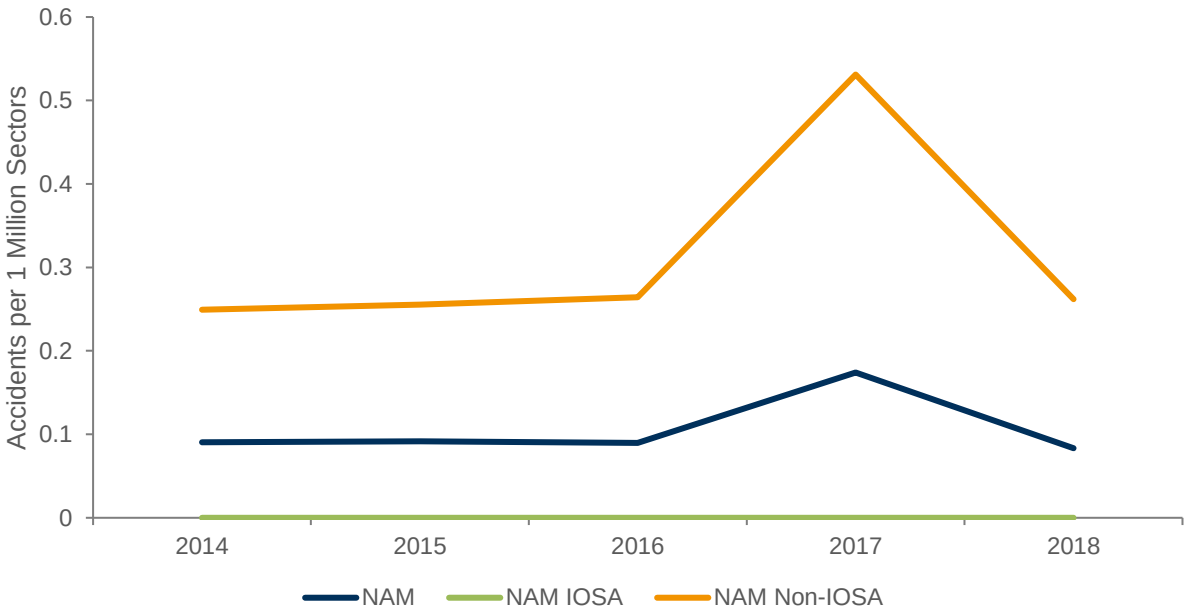
1.2 NAM Region Analysis

1.2.1 IATA Operational Safety Audit (IOSA) summary

The comparison of the number of recorded accidents per million sectors flown for IOSA registered airlines versus non-IOSA registered airlines in the NAM Region, indicated significantly lower rates for IOSA registered operators, as shown in the following figure:

2 An accident where at least one passenger or crewmember is killed or later dies (within 30 days following the accident date).

Figure 6. NAM Region IOSA v. Non-IOSA accident rates 2014-2018



1.2.2 Contributing Factors to 2014-2018 Accidents

Using a classification model based on the Threat and Error Management (TEM) framework, IATA identified contributing factors to NAM 2014-2018 accidents, as follows.

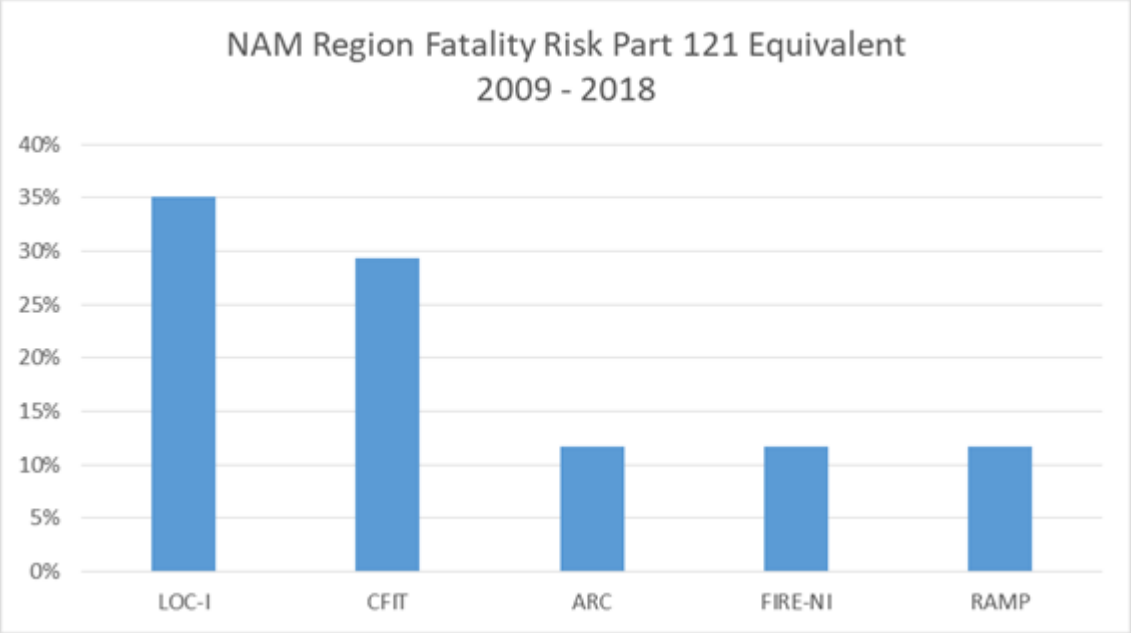
Table 3. Top Contributing Factors to NAM 2014-2018 accidents

Latent conditions	Regulatory Oversight (19%) Safety Management (13%) Maintenance Operations: SOPs & Checking (13%) Design (10%)
Threats (Enviromental)	Enviroment/Meteorology (35%) Wind/Windshear/Gusty wind (25%) Poor visibility/IMC (13%) Lack of visual reference (10%)
Threats (Airline)	Aircraft malfunction (38%) Gear/Tyre (21%) Manitenance events (13%) Fire/Smoke (Cockpit/Cabin/Cargo) (6%)
Flight Crew Errors	Manual Handling / Flight Controls (23%) SOP Adherence / SOP Cross-verification (21%) Pilot-to-Pilot Communication (6%)
Undesired Aircraft States	Vertical / Lateral / Speed Deviation (17%) Long/floated/bounced/firm/off-center/crabbed land (17%) Unstable Approach (8%) Continued landing after Unstable Approach (6%)
Countermeasures	Overall Crew Performance (17%) Monitor/Cross-check (13%) Leadership (8%) Workload Management (8%)

1.2.3 Fatality risk

The US CAST utilizes a model to determine fatality risk associated to accidents. For this analysis, accidents are classified in categories, based on specific characteristics of each occurrence, consistent with ADREP Taxonomy. According to the information provided by this stakeholder, the distribution of fatality risk in 2009-2018 accidents affecting Operators allocated on the NAM region, is presented in the following chart.

Figure 7. NAM Region fatality risk distribution by CICTT (2009-2018)



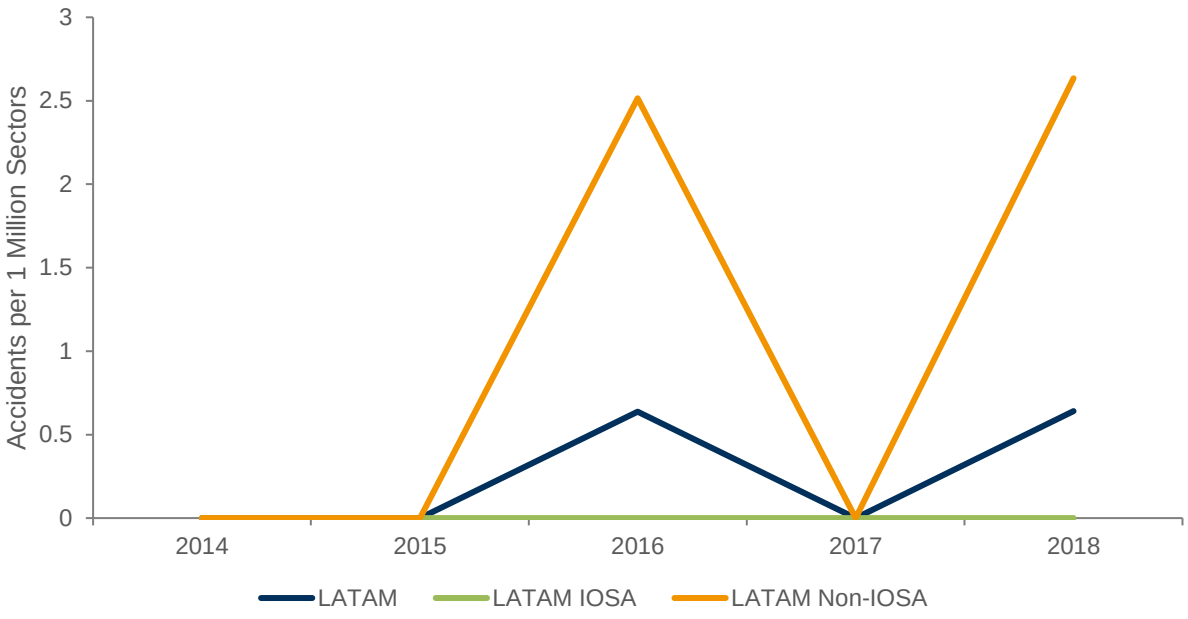
1.3 CAR and SAM Regions Analysis

Because of the ways of gathering and processing data made by the different stakeholders, in many cases it is not possible to separate CAR and SAM Regions data.

1.3.1 IATA Operational Safety Audit (IOSA) summary

The comparison of the number of recorded accidents per million sectors flown for IOSA registered airlines versus non-IOSA registered airlines in the Latin American and Caribbean IATA Regions (LATAM/CAR), indicated lower rates for IOSA registered operators, as shown in the following figure:

Figure 8. CAR and SAM Regions IOSA v. Non-IOSA accident rates 2014-2018



1.3.2 Contributing Factors to 2014-2018 Accidents

IATA identified the top contributing factors to CAR and SAM Regions 2014-2018 accidents, as follows.

Table 4. Top Contributing Factors to CAR and SAM 2014-2018 accidents

Latent conditions	Regulatory Oversight (39%) Safety Management (39%) Selection Systems (21%) Flight Ops: SOPs & Checking (18%)
Threats (Enviromental)	Meteorology (21%) Airport Facilities (21%) Thunderstorms (11%) Poor visibility/IMC (11%) Contaminated runway/Taxiway – poor braking action (11%)
Threats (Airline)	Aircraft Malfunction (43%) Gear/Tire (21%) Maintenance events (29%) Dispatch/Paperwork (14%) Operational pressure (11%)
Flight Crew Errors	SOP Adherence / SOP Cross-verification (21%) Manual Handling / Flight Controls (18%) Callouts (11%)
Undesired Aircraft States	Operation Outside Aircraft Limitations (14%) Unnecessary weather penetration (14%) Long/floated/bounced/firm/off-center/crabbed land (11%) Weight & Balance (7%)
Countermeasures	Overall Crew Performance (18%) Monitor / Cross-check (11%) Taxiway / Runway Management (7%)

1.3.3 Fatality risk

According to the information provided by The US CAST, the distribution of fatality risk for the accidents occurred within the 2009-2018 period affecting Operators with domicile in the CAR and SAM Regions, is shown in the following figures.

Figure 9. CAR Region fatality risk distribution by CICTT (2009-2018)

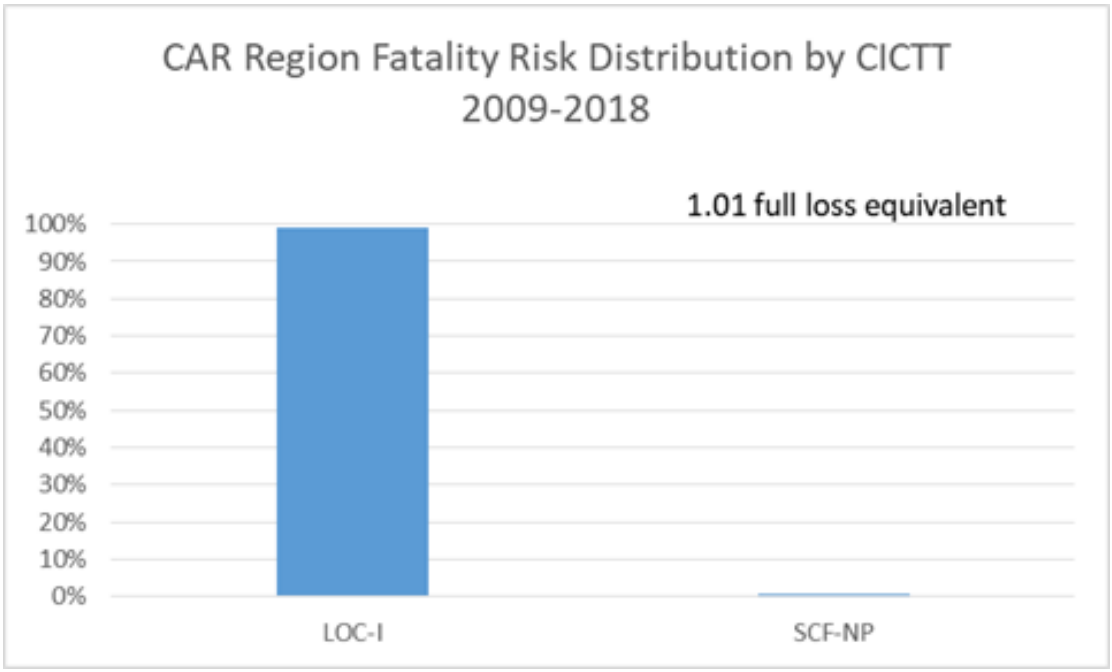
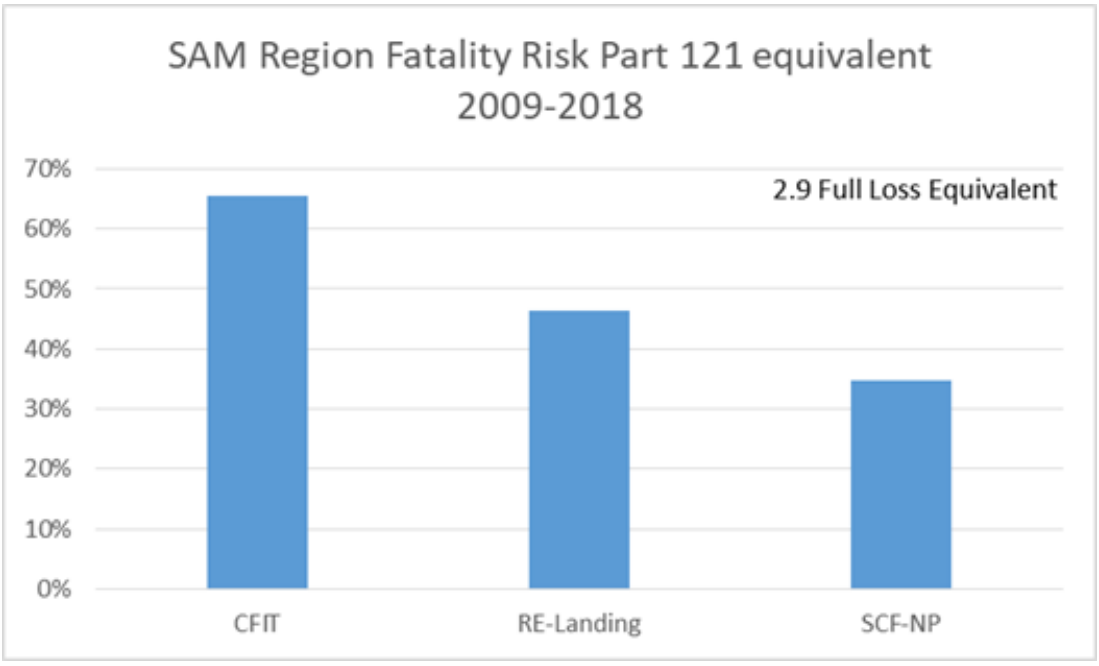


Figure 10. SAM Region fatality risk 2009-2018. Part 121 equivalent



1.3.4 Accident data in the SAM Region

The States of the SAM Region implemented the AIG Regional Coordination Mechanism (ARCM), in order to enhance regional accident and incident investigation and the related data. At the time of this version of the Annual Safety Report, European Coordination Centre for Accident and Incident Reporting Systems (ECCAIRS) has been implemented in the States of the SAM Region, and standardization and quality processes are under development.

1.3.5 RAIO in the CAR Region

The States of the CAR region have decided to seek regional collaboration for enhancing their Accident and Incident investigations (AIG) level of compliance, the creation of Regional Accident and Incident Investigation Organizations (RAIOs) is part of this approach. As part of this initiative, it is intended that a safety data collection and processing system will also establish to guarantee the collection, storage and management of accidents and incidents data of member States, likewise this system will strengthen establishing the necessary preventive measures to improve safety in the Region. Its development is currently being reviewed to obtain more progress in this regard.

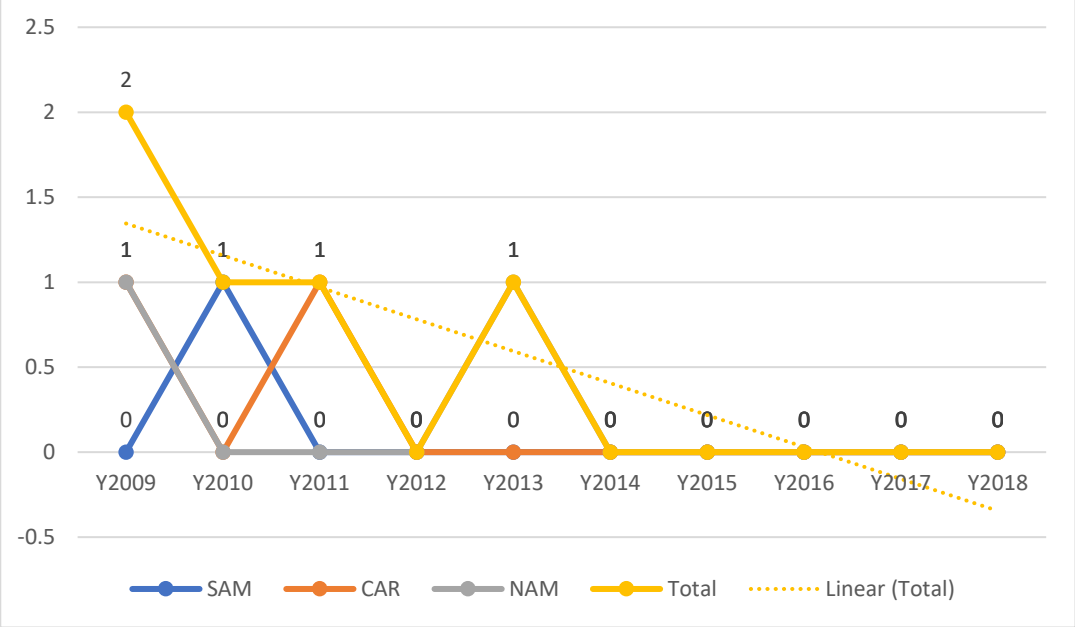
1.4 Specific analysis

After the determination of the most significant accident categories for the Pan American Region was made, a more in-depth analysis was performed to determine the behaviour and recurrent aspects of each category, to be considered in the safety decision making process.

1.4.1 Specific analysis of Controlled Flight Into Terrain

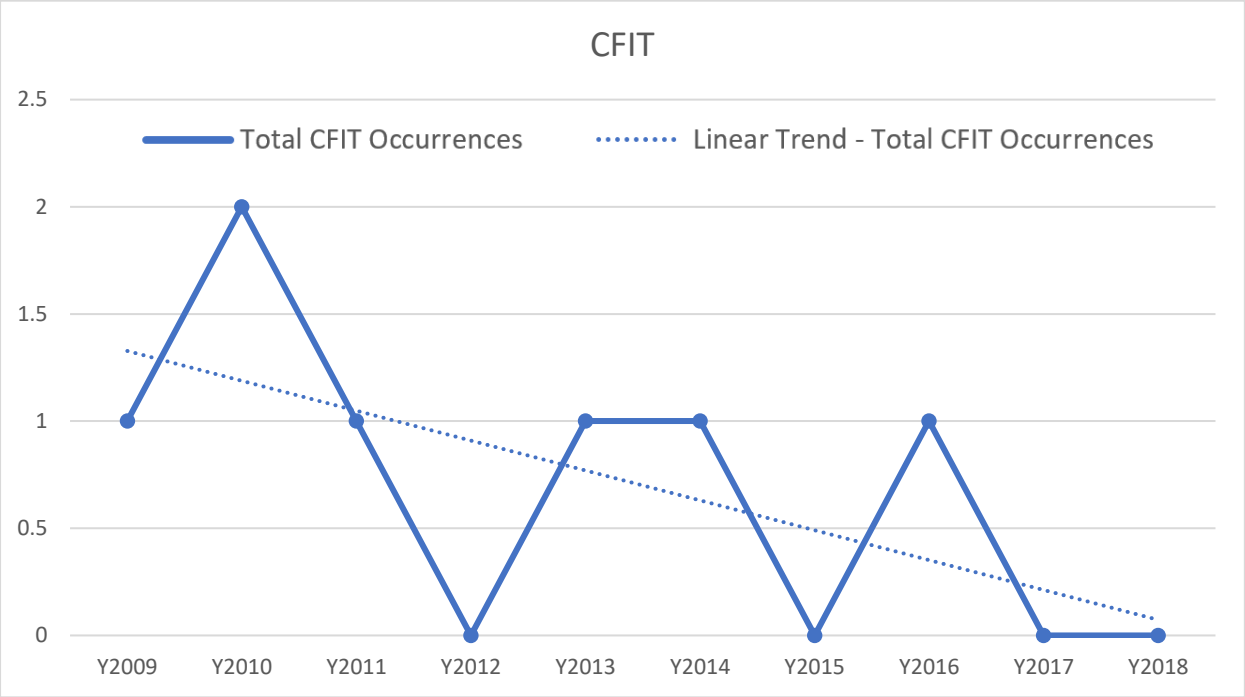
Accidents recorded by the ICAO Accident/Incident Data Reporting (ADREP) show a decreasing trend in the Pan American Region, as presented in the following chart.

Figure 11. CFIT accidents distribution per year by Region



Accident, serious incident and incident data provided by ICAO, showed an average of 0.7 total occurrences in the Pan American Region within the latest 10-year moving average (2009-2018), with a decreasing trend. The specific numbers of CFIT occurrences per year are presented in the following figure.

Figure 12. CFIT Total Occurrences Distribution per Year - Pan America



Contributing factors determined by IATA for Pan America CFIT accidents 2014-2018, were:

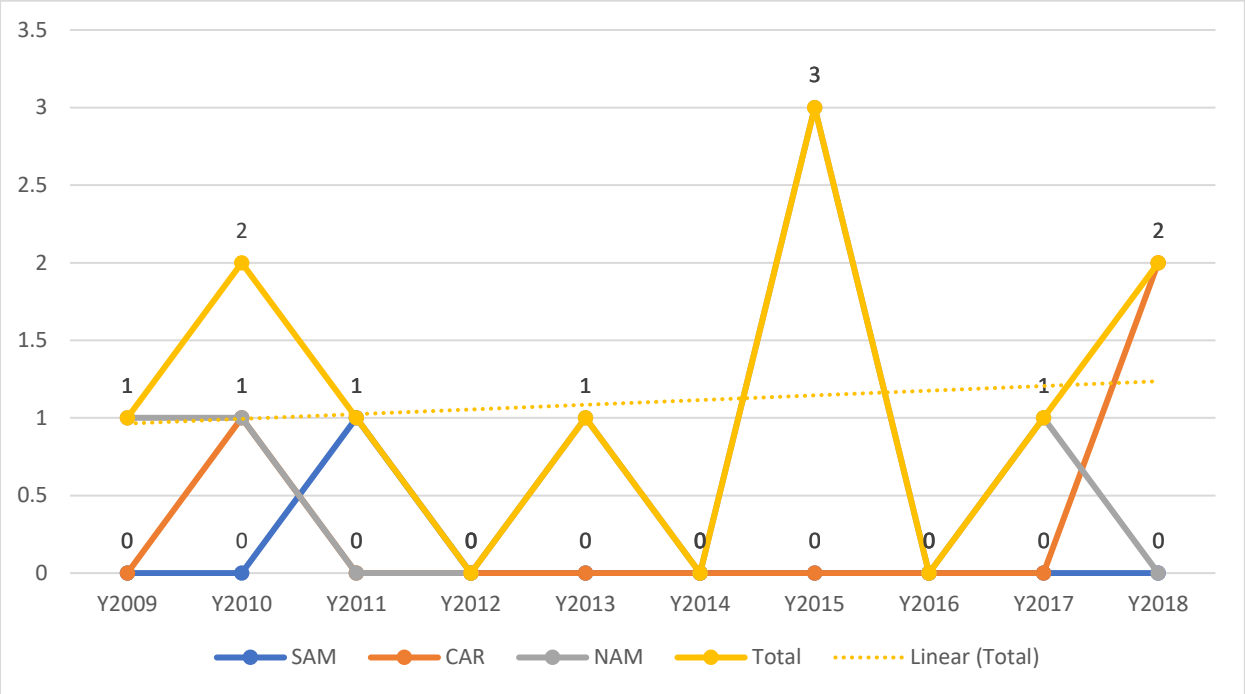
Table 5. Contributing factors to CFIT

Latent conditions	Management Decisions (100%) Regulatory Oversight (50%) Safety Management (50%) Technology & Equipement (50%)
Threats (Enviromental)	Lack of visual reference (100%) Nav Aids (50%) Ground based Nav Aid malfunction or not available (50%) Airport facilities (50%)
Threats (Airline)	Operational Pressure (50%) Dispatch/Paperwork (50%) Manuals/Charts/Checklists (50%)
Flight Crew Errors	SOP Adherence/SOP Cross-verification (33%) Manual Handling/Flight Controls (50%)
Undesired Aircraft States	Controlled Flight into Terrain (100%) Unnecessary Weather Penetration (50%) Long/Floated/Bounced/Firm/Off-center/Crabbed land (50%)
Countermeasures	Monitor / Cross-check (100%) Overall Crew Performance (50%)

1.4.2 Specific analysis of Loss of Control In-flight

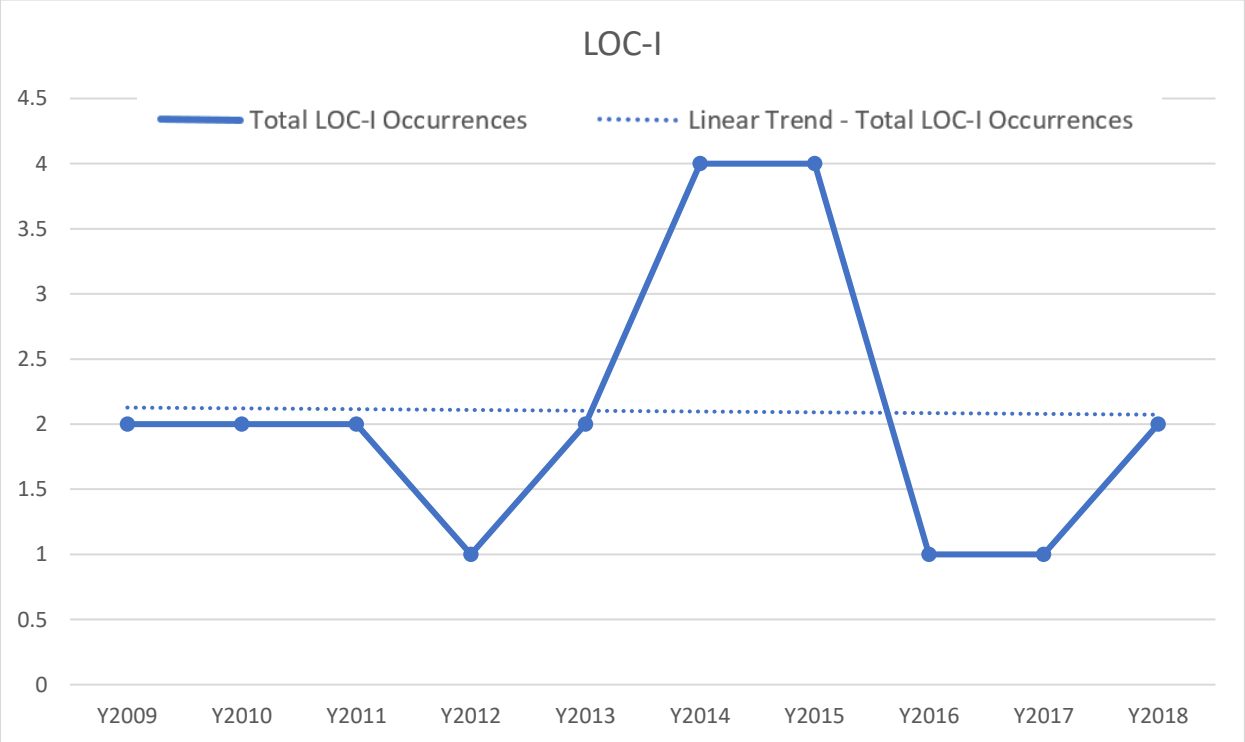
Accidents recorded by the ICAO-ADREP show a slightly increasing trend through the latest ten-year period, as presented in the following figure.

Figure 13. LOC-I accidents per year by Region



According to ICAO accident, serious incident and incident data, LOC-I total occurrences showed an average of 2.1 per year, with a decreasing trend in the period 2009-2018. The distribution of LOC-I occurrences per year is shown in the following figure.

Figure 14. LOC-I Total Occurrences Distribution per Year - Pan America



Contributing factors determined for Pan America Loss of Control In-flight 2014-2018 accidents by IATA were:

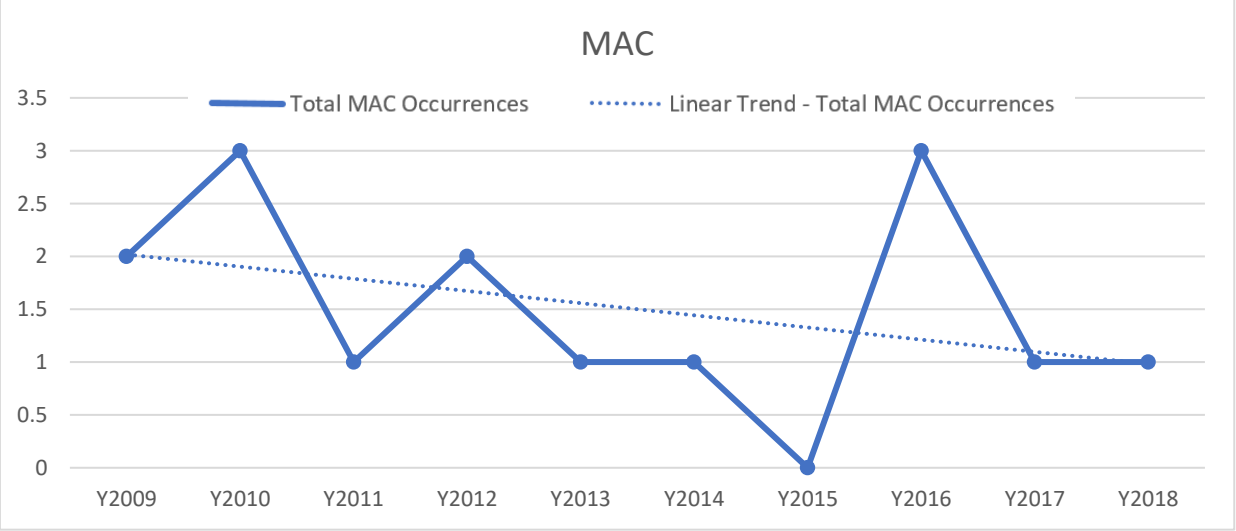
Table 6. Contributing factors to LOC-I

Latent conditions	Regulatory Oversight (50%) Safety Management (50%) Selection Systems (33%) Flight ops: Training Systems (33%)
Threats (Enviromental)	Meteorology (33%) Thunderstorms (17%) Wind/Windshear/Gusty wind (17%) Lack of visual Reference (17%)
Threats (Airline)	Ground Events (17%)
Undesired Aircraft States	Operation Outside Aircraft Limitations (33%) Unnecessary Weather Penetration (17%) Weight & Balance (17%)

1.4.3 Specific analysis of Mid Air Collision

Accident, serious incident and incident data provided by ICAO, showed 15 MAC occurrences in total, for the time frame from 2009 to 2018, in the Pan American Region, with a decreasing trend, as presented in the following figure.

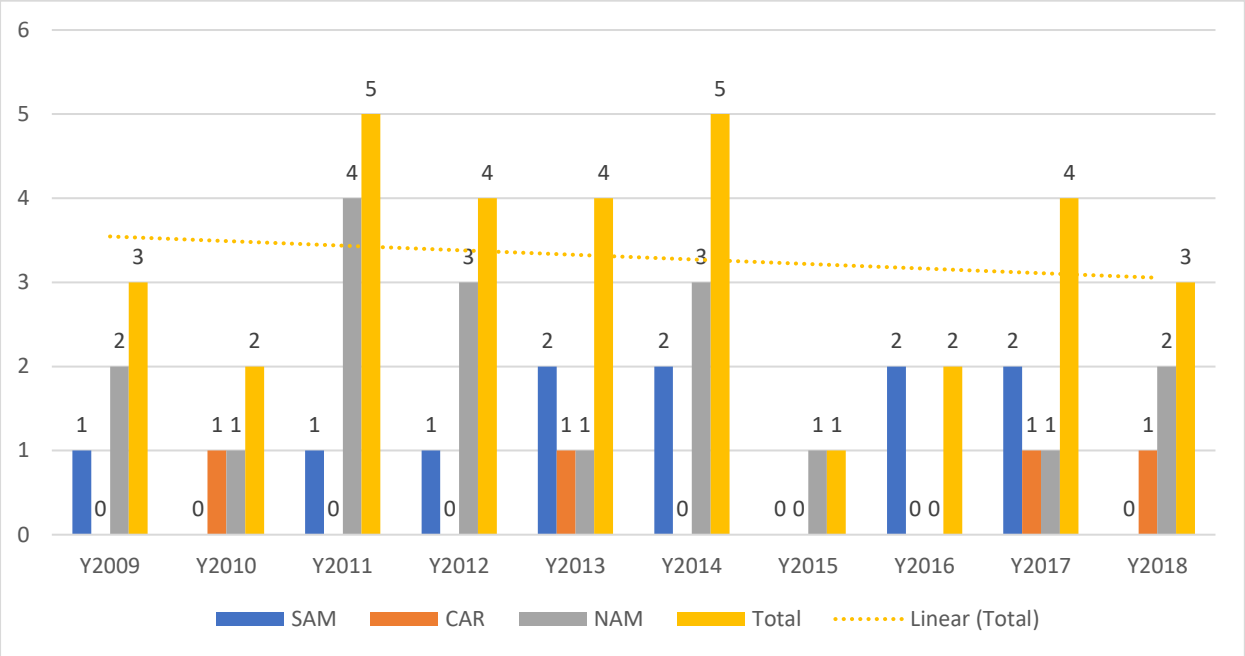
Figure 15. MAC Total Occurrences Distribution per Year – Pan America



1.4.4 Specific analysis of Runway Excursion

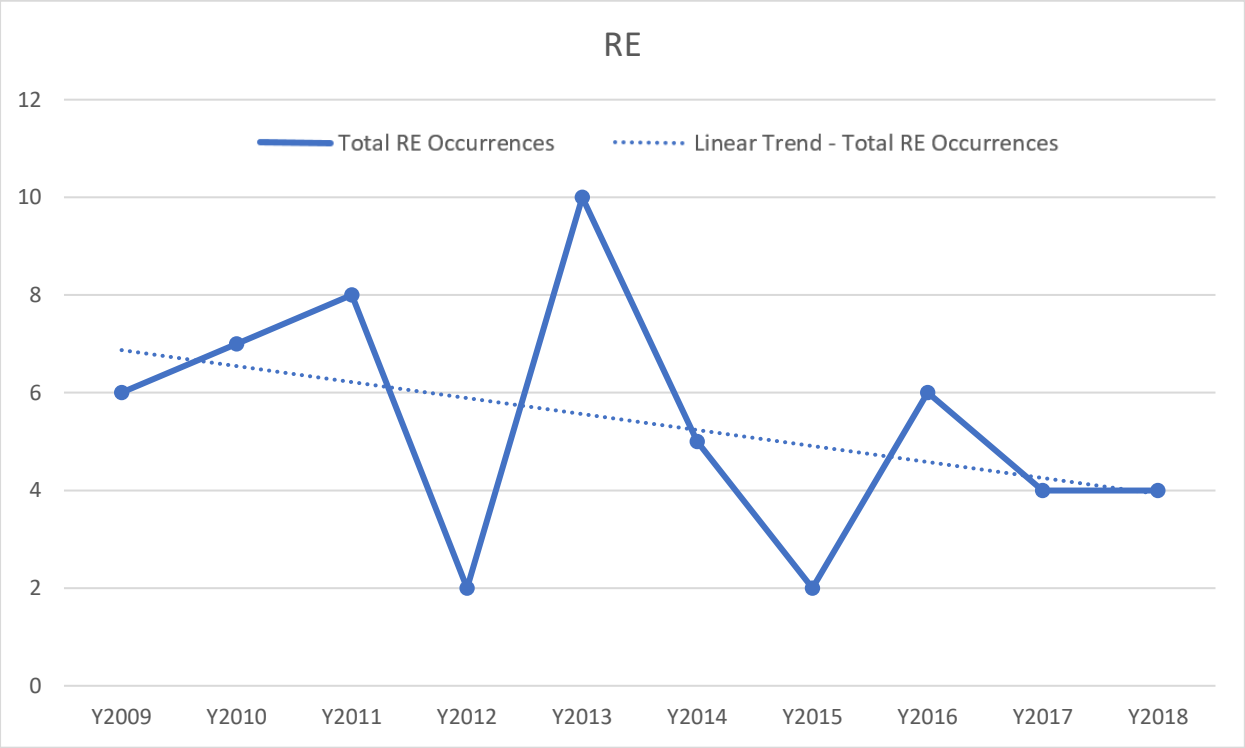
Accidents recorded by the ICAO-ADREP for the 2009-2018 period show a decreasing trend, as presented in the following figure.

Figure 16. RE accidents per year by Region



Accident, serious incident and incident data provided by ICAO, showed 33 runway excursions (an average of 3.3 per year) in the last 10-year moving period (2009-2018) with a decreasing trend. The most frequent categories associated to Runway Excursion (RE) were Abnormal Runway Contact (ARC) (21.2% of REs) and System/Component Failure or Malfunction non-powerplant (SCF-NP) (21.2% of REs), all of them showing decreasing trends. The number of REs per year are depicted in the following figure.

Figure 17. RE Total Occurrences Distribution per Year - Pan America



Contributing factors for Pan America Runway Excursions 2014-2018 determined by IATA are shown in the following table:

Table 7. Contributing factors to RE

Latent conditions	Safety Management (18%) Regulatory Oversight (12%) Design (12%)
Threats (Enviromental)	Meteorology (29%) Wind/Windshear/Gusty wind (24%) Airport Facilities (24%) Contaminated runway/Taxiway – poor braking action (18%)
Threats (Airline)	Aircraft Malfunction (41%) Contained Engine Failure/Powerplant Malfunction (6%) Maintenance events (6%) Hydraulic System Failure (6%)
Flight Crew Errors	SOP Adherence / SOP Cross-verification (29%) Manual Handling / Flight Controls (18%) Callouts (12%)
Undesired Aircraft States	Long/floated/bounced/firm/off-center/crabbed land (29%) Brakes / Thrust Reversers / Ground Spoilers (12%) Rejected Take-off after V1 (12%) Engine (12%)
Countermeasures	Overall Crew Performance (24%) Monitor/Cross check (12%) Taxiway/Runway Management (12%)

2. Proactive Safety Information

This section is intended to apply the proactive methodology to show the risk exposure level in aviation, based upon the results of safety oversight and management processes.

At the level of the States, ICAO USOAP-CMA results and data from the Data Exchange Program of Ramp Safety Inspections (IDISR program) were used to establish the current context for safety.

At the level of the operator, IOSA results were used by IATA to identify latent conditions that eventually could affect safety.

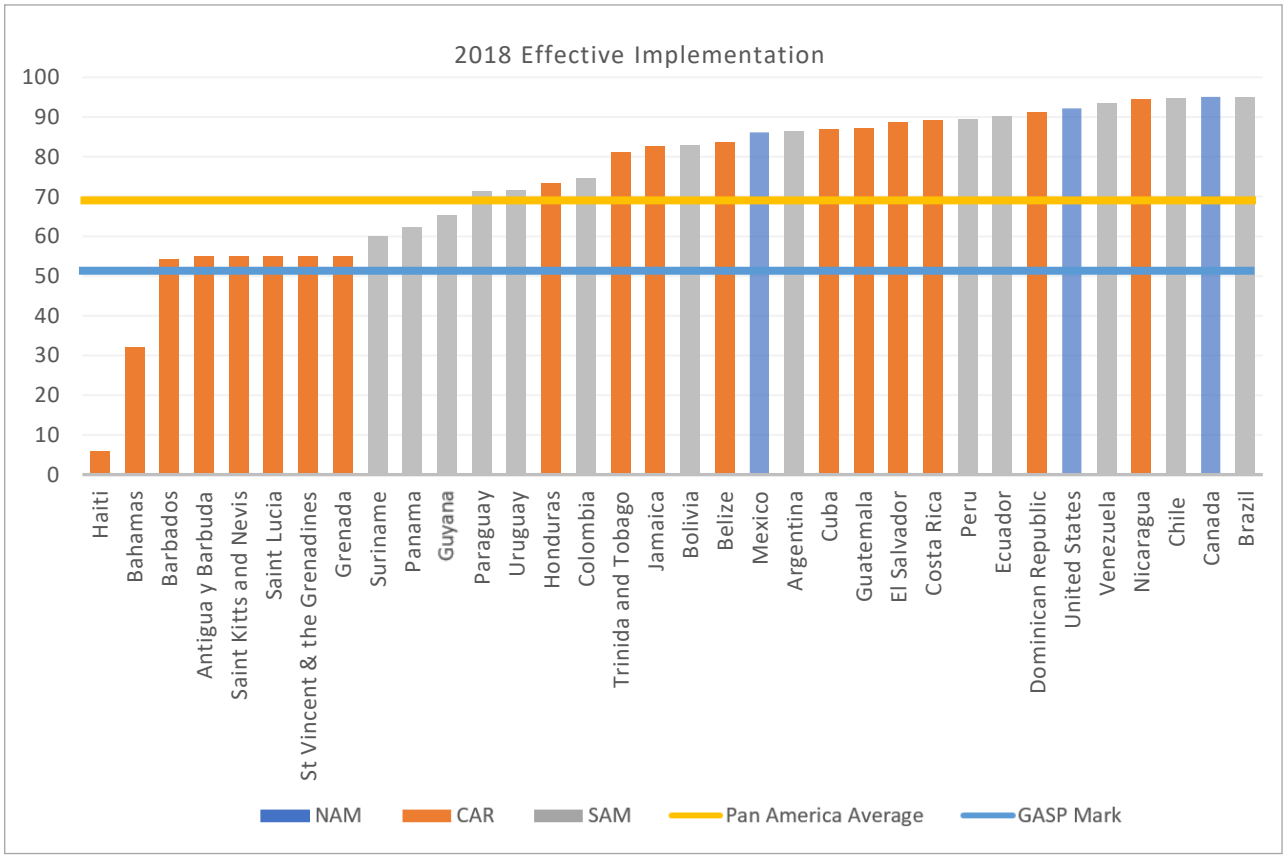
2.1 Proactive information at the level of the States

2.1.1 ICAO Universal Safety Oversight Audit Programme - Continuous Monitoring Approach (USOAP-CMA)

It is essential to ICAO that States establish, maintain and improve the eight critical elements of an effective safety oversight system, as well as the eight technical areas.

The following figure shows detailed distribution of the percentage of Effective Implementation (EI) by State in the Pan American Region, based upon the latest USOAP audit or Coordinated Validation Mission (ICVM).

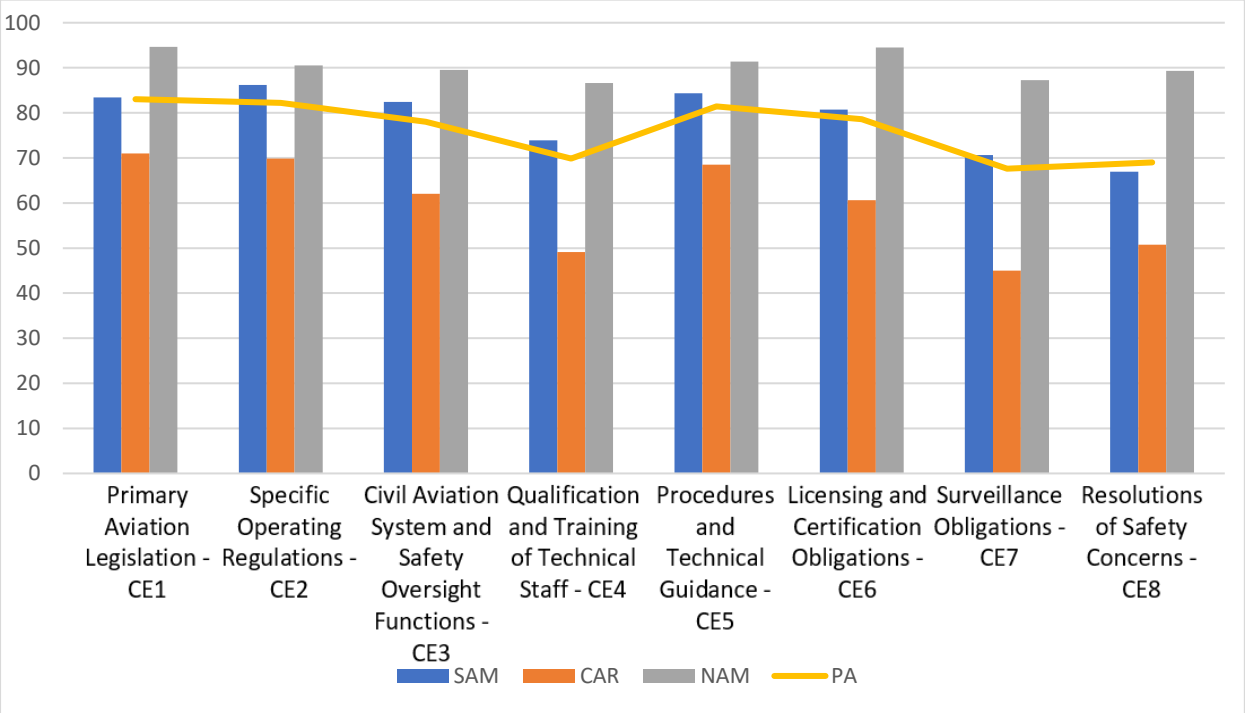
Figure 18. Percentage of Effective Implementation per State by Region



According to the previous chart, the average effective implementation in the Pan American Region increased from 65.2% in 2010 to 74.59% as of December 2018, achieved as result of the audits conducted on 31 States in the Region. According to ICAO Global Aviation Safety Plan (GASP), States should target their efforts to increase and maintain effective implementation above 60%.

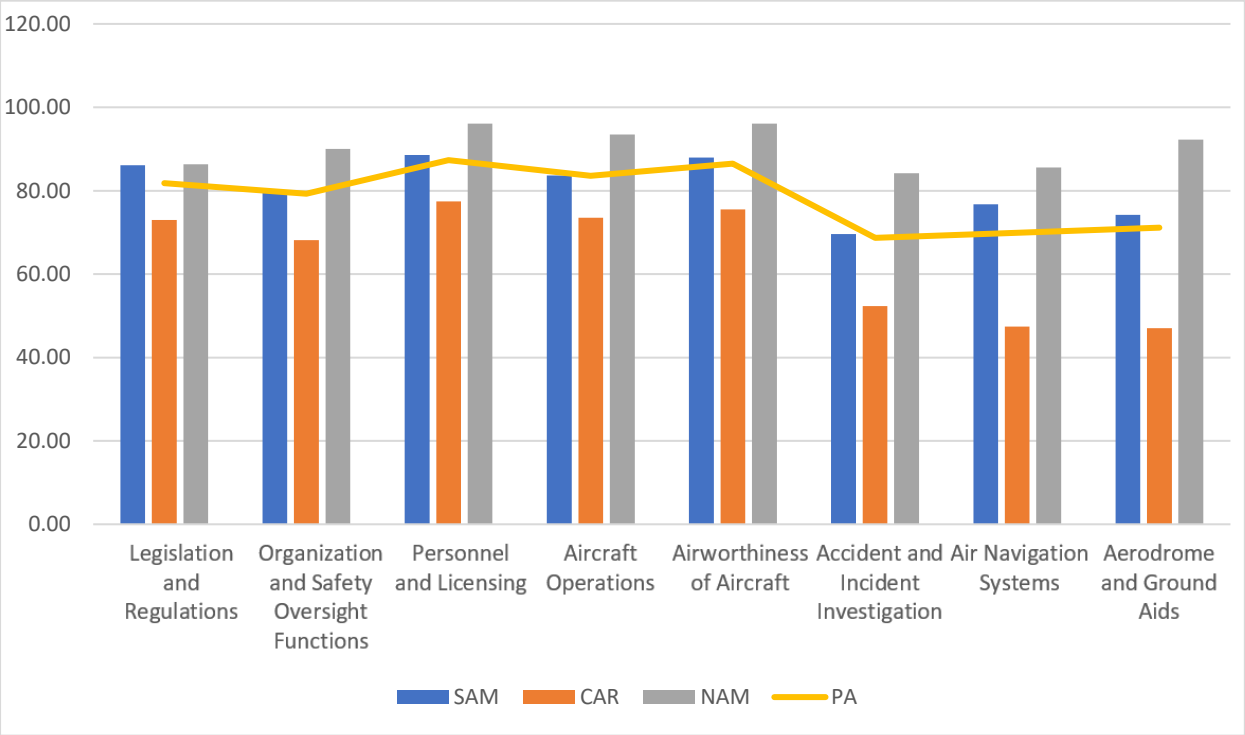
According to ICAO USOAP and ICVM information, the CEs showing the lowest percentage of effective implementation in the Pan American Region are **CE7: Surveillance obligations** and **CE8: Resolution of Safety Concerns**. This and other facts are shown in the following figure:

Figure 19. Percentage of Effective Implementation per CE by Region



Regarding the eight technical areas, AIG, AGA and ANS continue to be the areas that show the lowest levels of effective implementation, especially in the CAR Region, as presented in the following figure:

Figure 20. Percentage of Effective Implementation per Area by Region



To determine the correlation of areas and critical elements, an analysis of the allocation of findings was conducted, using the integrated Safety Trend Analysis and Reporting System (iSTARS). The following tables show the average findings per area and critical element for each Region.

Table 8. NAM Region USOAP CMA average finding per area v. CE

CE	LEG	ORG	AIG	PEL	OPS	AIR	ANS	AGA
CE1	1		1		1			
CE2	2		1	2	2	3	3	4
CE3			3		1		4	
CE4			2		1	1	3	1
CE5			5		1	3	2	
CE6				2	6	2	5	2
CE7				1		3	5	
CE8			3				1	

In the case of the NAM Region, the highest numbers were in OPS/CE6, specifically regarding the existence of a flight data analysis programme as part of the operator's Safety Management System (SMS).

Table 9. CAR Region USOAP CMA average finding per area v. CE

CE	LEG	ORG	AIG	PEL	OPS	AIR	ANS	AGA
CE1	3	1	3	1	1	5	2	1
CE2	3		4	3	4	6	4	9
CE3		3	4	3	3	4	17	3
CE4		2	4	4	3	3	18	3
CE5	1	1	12	5	7	9	5	6
CE6			11	7	11	5	19	26
CE7			6	3	4	3	14	12
CE8			6	2	3	4	5	5

In the case of CAR Region, main findings regarding AGA/CE6 were related to the systems in place in the States to ensure certain aspects of aerodromes certifications such as documentation clearance, compliance with the regulations by the aerodrome operator, especially with regard to aerodrome data, determination and reporting of pavement bearing strengths, emergency plans and provision of power supplies.

Table 10. SAM Region USOAP CMA average finding per area v. CE

CE	LEG	ORG	AIG	PEL	OPS	AIR	ANS	AGA
CE1	3	1	4		1	5	1	1
CE2	2		3	3	4	4	3	4
CE3		3	4	1	2	2	7	2
CE4		1	4	2	3	3	11	2
CE5	1	1	12	1	3	6	2	3
CE6			3	5	11	5	12	17
CE7				3	4	2	10	9
CE8			5	2	3	3	5	4

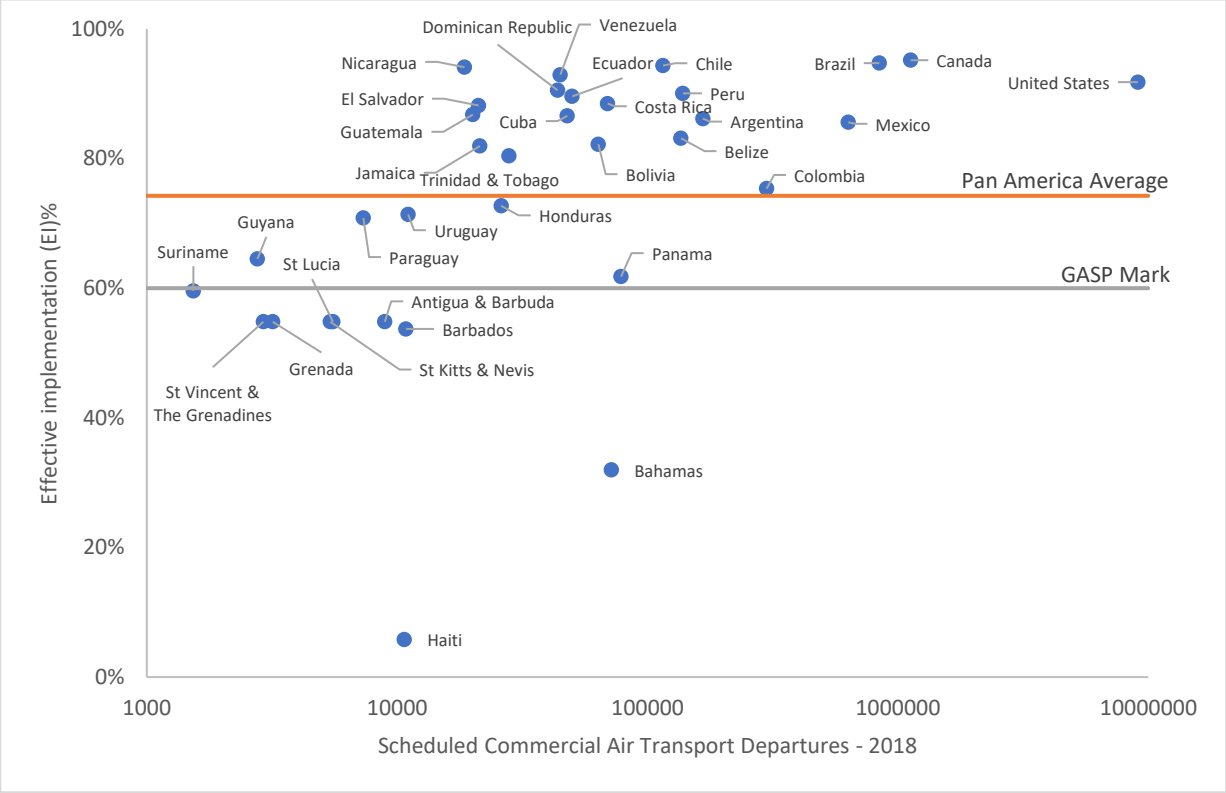
In the case of SAM Region, the highest numbers were reached in AGA/CE6, mainly on the assurance of aerodrome operators employing competent personnel for critical activities, a quality system to ensure data compliance, integrity, accuracy and protection, safety of the runway surrounding areas and integration of lighting, marking and signals as part of the aerodrome's runway incursion and collision avoidance strategy.

According to the ICAO Global Air Transport Outlook to 2030, forecasts for total Latin America and Caribbean passenger traffic call for an annual growth rate of 5.9% to 2030. By 2030, Latin America and Caribbean international markets are expected to account for 74% of the total passenger traffic from, to and within the region.

Considering the projected traffic growth, the RASG-PA highly recommends that the CAR and SAM Regions continuously monitor and improve the implementation of the ICAO Standards and Recommended Practices (SARPs), which could result in minimizing exposure to the associated risk derived from traffic growth, especially in CE7 and CE8, and also in the areas of ANS, AGA and AIG.

Figure 22 shows a comparison between EI and traffic volume (departures) by Pan American States in 2017, based upon ICAO iSTARS data, which could be an indicator for risk exposure to States.

Figure 21. Effective Implementation vs. 2017 departures by State



2.1.2 IDISR Program

The Data Exchange Program of Ramp Safety Inspections (IDISR) is a reporting system designed to store, process and share information on ramp inspections conducted on foreign operators (under LAR 129) within the Member States of the SRVSOP which includes 11 States of the SAM Region and 1 from the CAR Region.

In 2018, IDISR initiated the migration of its database into ICAOs Safety Information Monitoring System (SIMS) to benefit from global exchange of data.

Since 2008 until 2018, IDISR recorded more than 4,000 inspections with an average of 0.43 findings per inspection.

2.2 Information at the level of the Air Operators

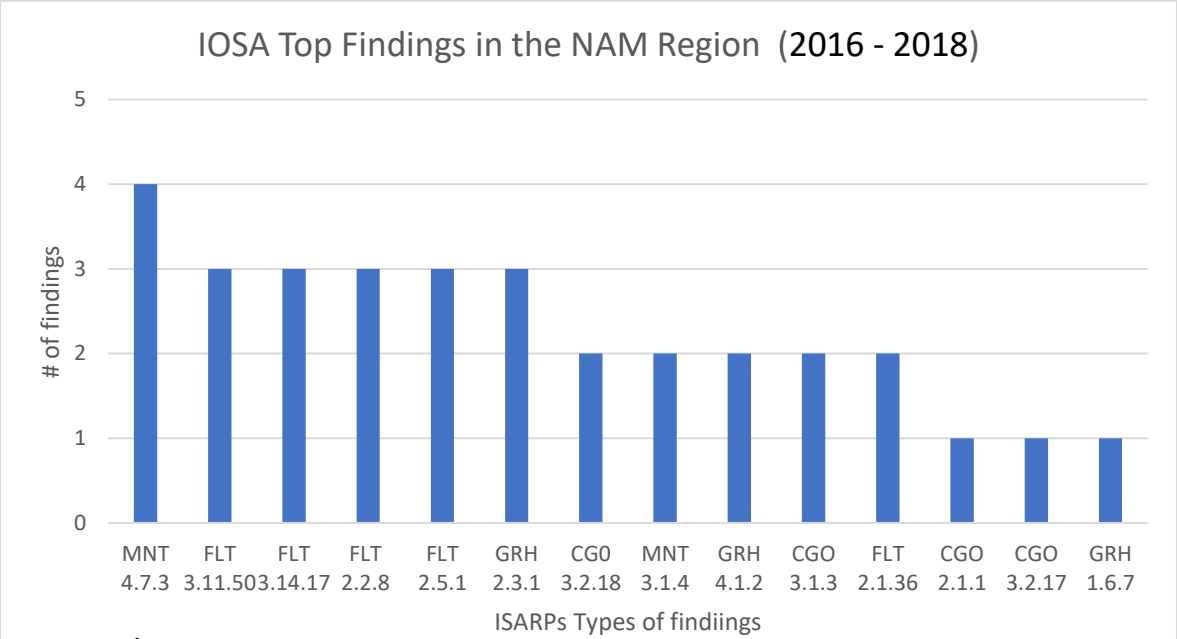
2.2.1 IOSA main findings

IATA prepared a review of the IOSA Standards and Recommended Practices (ISARPs), related to LOC – I, CFIT, and RE including the top findings in the NAM and the LATAM/CAR region. References for each of the findings in the eight (8) disciplines Organization (ORG), Flight Operations (FLT), Dispatch (DSP), Cabin (CAB), Maintenance (MNT), Cargo (CGO), Ground Operations (GRH) and Security (SEC) can be found in the IOSA Standards Manual (ISM) documentation through

https://www.iata.org/whatwedo/safety/audit/iosa/documentation/Pages/default.aspx.

In the NAM region, the top three (3) findings for the period under review were related to guidance that requires flight crews, when operating an aircraft at low heights above ground level (AGL), to restrict rates of descent for the purposes of reducing terrain closure rate and increasing recognition/response time in the event of an unintentional conflict with terrain (ISARPs FLT 3.11.50); maintenance organization having an Electrostatic Sensitive Devices (ESD) Program (ISARPs MNT 4.7.3); and dangerous goods report made to the appropriate authorities of the State of the Operator and the State of Condition Origin (ISARPs CGO 3.2.18). The figure below shows findings.

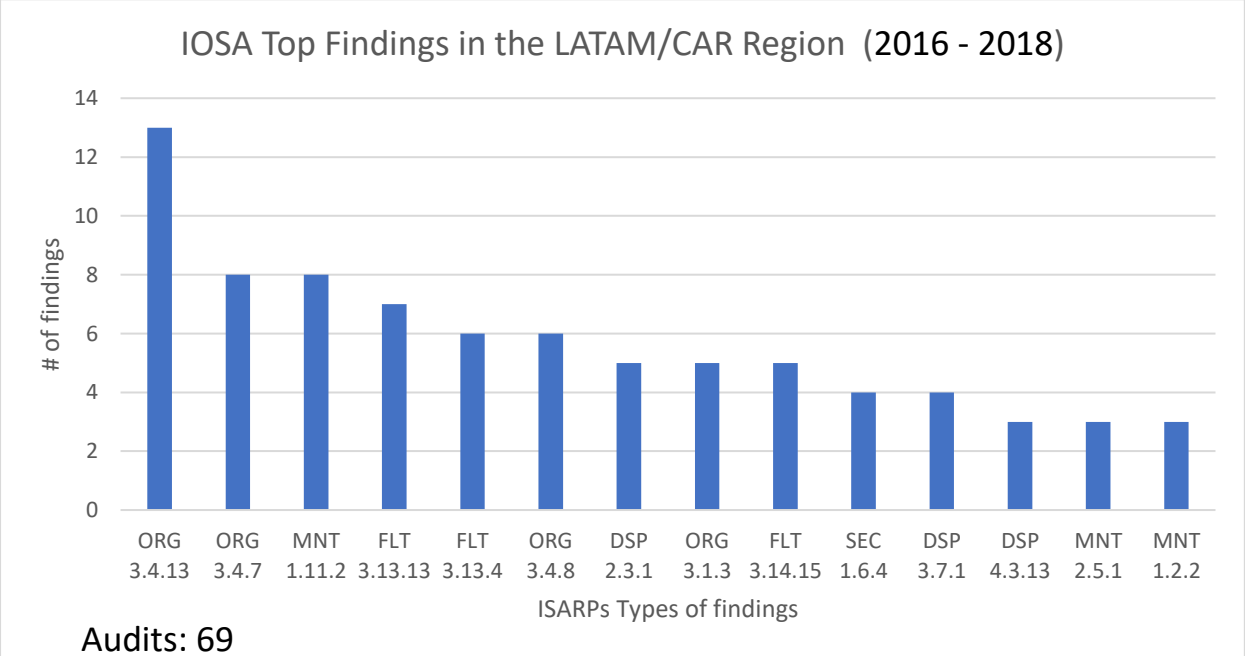
Figure 22. IOSA Top Findings in the NAM Region



Audits:

In the LATAM/CAR region, the top three (3) findings for the period under review were related to training and qualification program for auditors that conduct auditing under the quality assurance program as specified in ISARP ORG 3.4.1 (ISARPs ORG 3.4.13); a process for the production of a Conformance Report (CR) that is certified by the accountable executive (or designated senior management official) as containing accurate information related to the audit of all ISARPs as is specified in ORG 3.4.6 (ISARP ORG 3.4.7); and having flight crew procedures for transport of passengers and/or supernumeraries without the use a cabin crew (ISARPs FLT 3.13.13). The figure below shows the findings

Figure 23. IOSA Top Findings in the LATAM/CAR Region

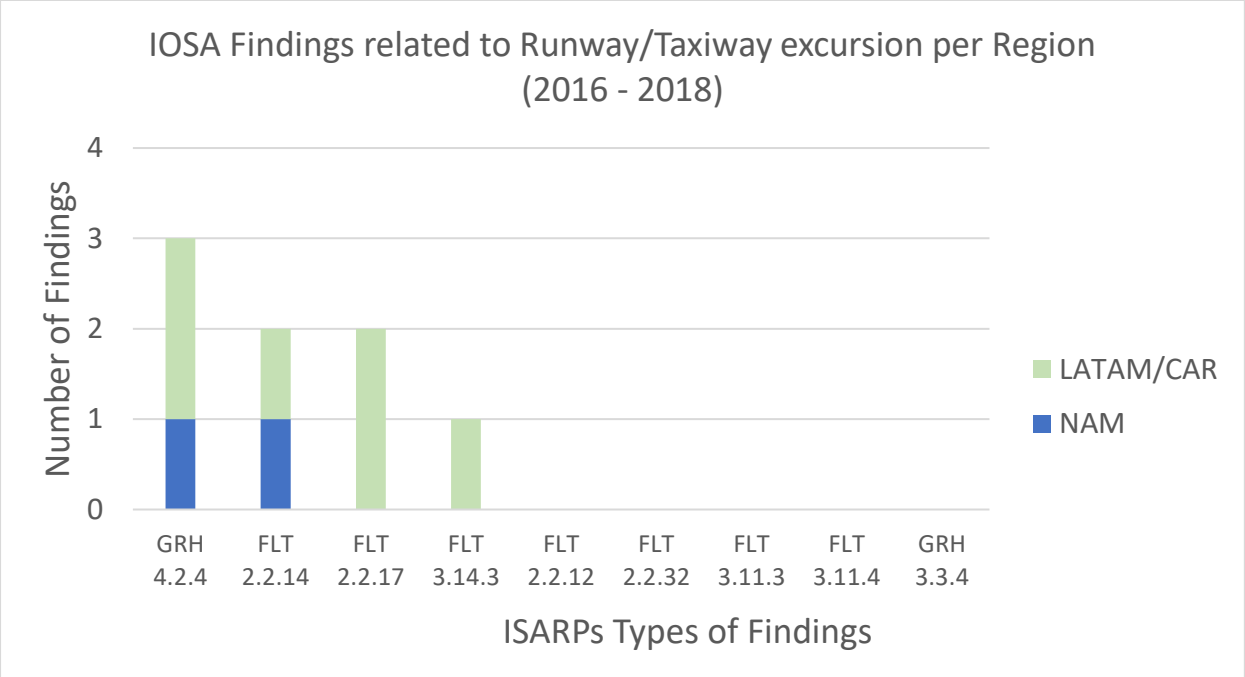


Audits: 69

To assist operators in better understanding the latent conditions related to the high-risk accident categories on RE, LOC-I and CFIT, the top findings for the Pan American region are shown in the accompanying figures.

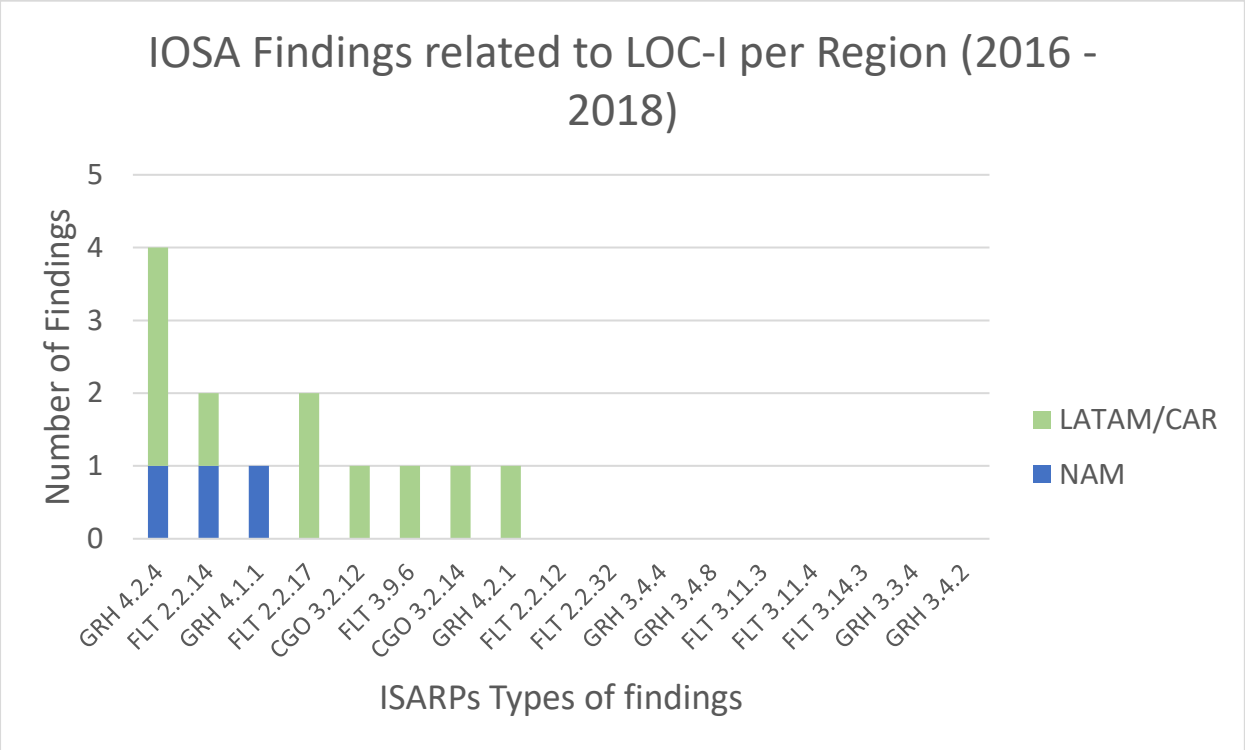
Figure 25 presents the top findings associated with RE for the period under review. ISARP GRH 4.2.4 remains a top factor which is regarding the storage and handling of fluids used in de-icing and anti-icing operations for operators with De-/Anti-Icing programs.

Figure 24. IOSA Findings related to Runway/Taxiway excursion per Region



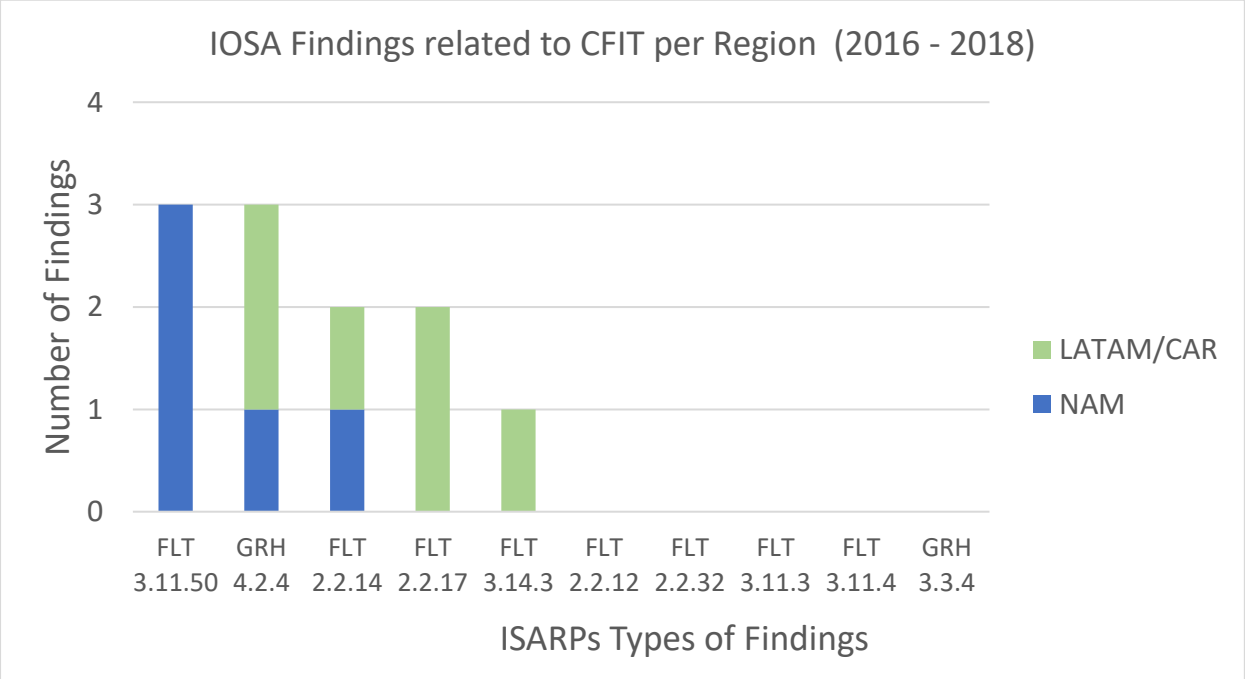
The top findings associated with LOC-I can be seen in the figure below. ISARP FLT 2.2.14 which addresses complete training in procedures for aircraft upset recovery during initial ground training and subsequently during recurrent training still remains for period under review amongst other areas in FLT, GHR and CGO ISARPs.

Figure 25. IOSA Findings related to LOC-I per Region



The top findings associated with CFIT for the period under review remains guidance regarding operating an aircraft at low heights AGL, to restrict rates of descent for the purposes of reducing terrain closure rate and increasing recognition/response time in the event of an unintentional conflict with terrain (ISARPs FLT 3.11.50).

Figure 26. IOSA Findings related to CFIT per Region



3. Predictive Safety Information

This section is intended to use the predictive methodology to represent the analysis of data captured during regular airline operations. Specifically, this analysis refers to FOQA/ Flight Data Analysis (FDA) events that occurred in the CAR and SAM Regions, showing conditions that could be considered as precursors of the most significant accident categories. This information was shared with RASG-PA under Memorandums of Understanding (MOUs).

CARSAMMA provided data on LHDs in the Reduced Vertical Separation Minima or Minimum (RVSM) airspace of the CAR and SAM Regions.

As part of the safety oversight in the RVSM airspace of the CAR and SAM regions, the States, in coordination with the Regional Monitoring Agency (RMA) CARSAMMA, carry out a follow-up of all LHDs detected in the airspace.

Each deviation has an initial validation process, and then the total information is validated by the States focal points, this process ensures that all the events considered for the calculation of the RVSM safety level, fulfil the criteria, as part of the RVSM Target Level of Safety RVSM assuring process.

Table 11 shows the validated LHDs per month as well as the total monthly time in minutes, parameters that are considered to determine the RVSM Target Level of Safety (TLS).

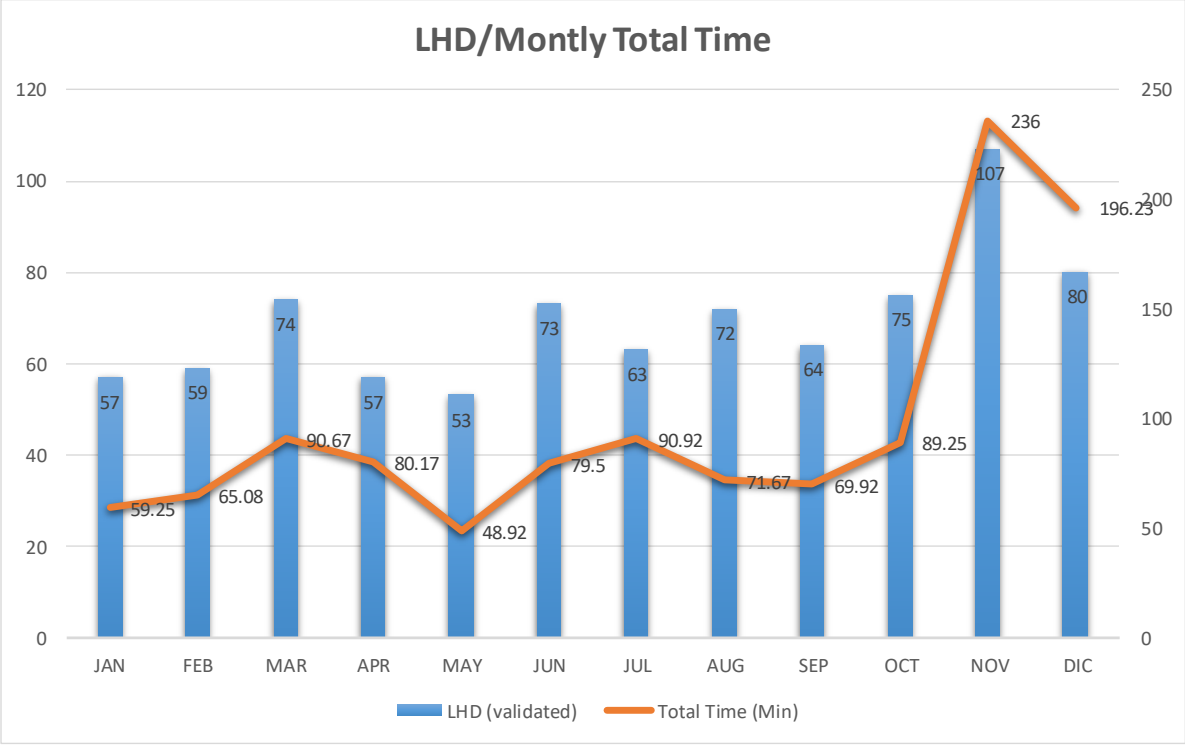


Table 11

The Collision Risk Methodology (CRM) has been used for the safety assessment of RVSM airspace in the Caribbean and South America. The estimated values of the CRM on operational and technical error result from processing all LHDs received and validated in 2018.

The sample data to estimate the pass frequency and physical parameters, as well as the dynamics of a typical aircraft for the assessment of vertical collision risk were collected from 1 December to 31 December 2018 from the 34 CAR/SAM Flight Information Regions (FIRs) with a total of 1,038,066 hours of flights.

The risk values (table 12) were estimated based on the FIR values obtained after processing all data received, compiled and processed in the specific CRM software:

a) **The estimated total risk for the assessed FIRs is 2.32 x 10-9 under the TLS (5.0 x 10-9).**
b) The technical risk of the CAR/SAM FIRs meets the TLS value, not exceeding 2.5 x 10-9 fatal accidents per flight our due to loss of the standard vertical separation of 1,000 ft and all other causes.
c) The operational risk does not have a predefined limit, in accordance with ICAO Doc 9574.

Source of risk	Estimated risk	TLS
Technical risk	**0.0401×10^{-9}**	**2.5×10^{-9}**
Operational risk	**2.28×10^{-9}**	-
Total risk	**2.32×10^{-9}**	**5.0×10^{-9}**

Table 12 CAR/ SAM Risk Levels

The CAR/SAM regions showed an annual reduction in the number of LHDs received and validated (Table C). Although this trend has remained the same during the last triennium (2016-2018), the behaviour of the risk level has been the opposite, showing an upward trend during the same period (Table D). The 2018 risk level increased by 6.45×10^{-1}, with respect to 2017. Although the CAR/SAM Regions are below the TLS, the States and Air Traffic Services (ATS) providers are developing strategies to reduce the trend.

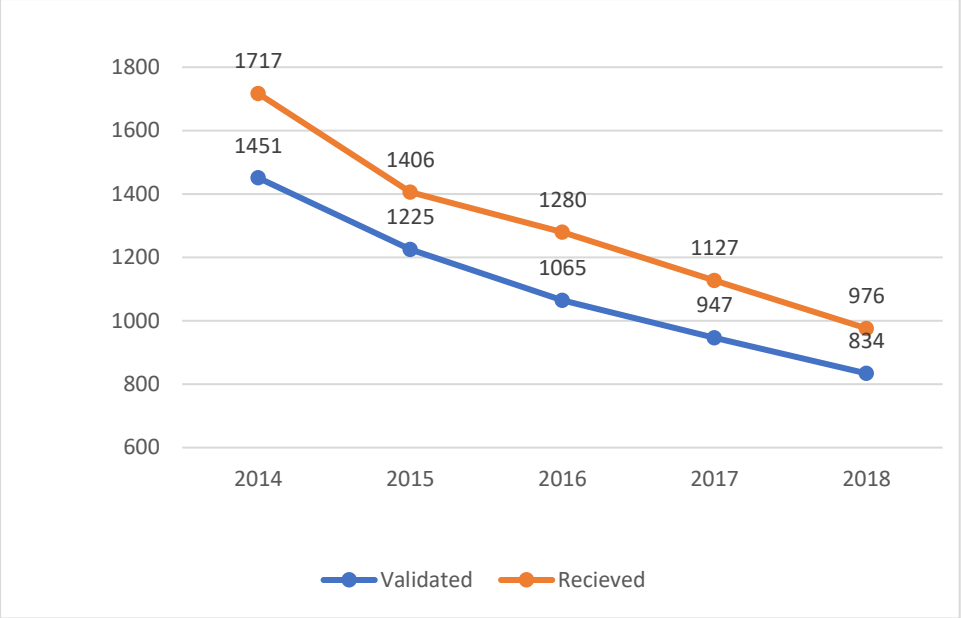


Table 13

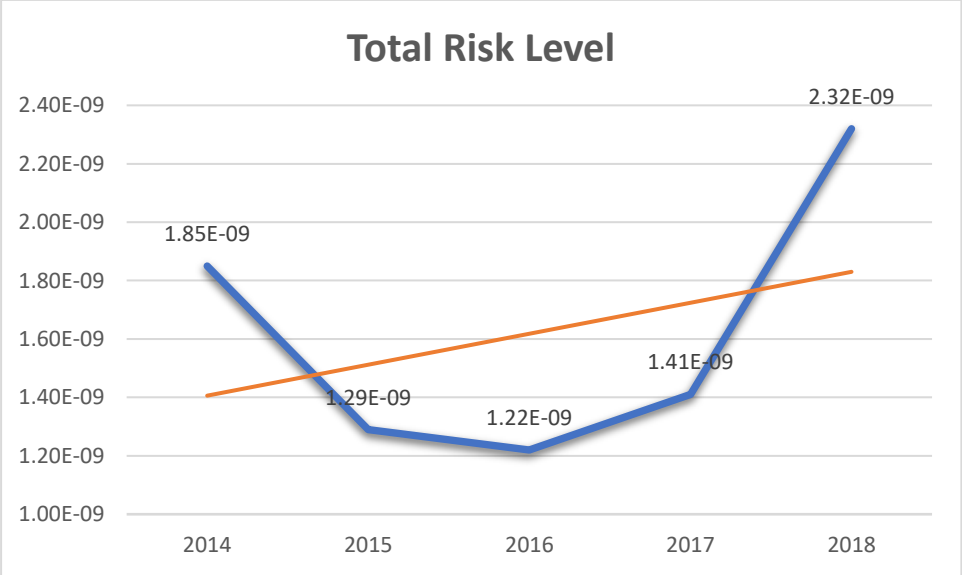


Table 14

Part Two: Safety Intelligence

This part of the report is intended to present correlations and conclusions based on the information contained of the first part.

To be consistent with the structure of the first part of the report, conclusions are described according to the safety analysis methodologies, and correlations are the result of the cross-sectional analysis, thus increasing the frame of reference for safety decision making process.

1. Conclusions based on reactive information

- Accidents in the Pan American Region showed a decreasing trend across the ten years period analyzed (2009-2018). In 2018 the accident rate was higher than world average.
- The analyzed reactive data also highlighted Loss of Control In-flight (LOC-I), Runway Excursion (RE), Controlled Flight into Terrain (CFIT) continue to be the top categories of interest in the Pan American Region. All high risk categories but LOC-I showed decreasing trends across the period.
- As it relates to the Mid-Air Collision (MAC) category, serious incident and incident data, showed a decreasing trend.
- Management decisions, Safety management, and Regulatory oversight were identified as the top latent conditions for 2013-2018 accidents in the both North America and Latin America & Caribbean regions.

2. Conclusions based on proactive information

- Since the last edition of this report, the level of effective implementation (EI) of the critical elements (CEs) below 60% decreased from 10 to 8 States in the Pan American Region according to the ICAO Universal Safety Oversight Audit Programme - Continuous Monitoring Approach (USOAP-CMA). Also, the regional effective implementation average improved in more than 9% since 2010.
- USOAP findings on Licensing and Certification obligations (CE 6) in the operations area (OPS) was the most common in NAM Region, related to the existence of a flight data analysis as part of SMS operators. In the case of CAR and SAM Regions, main findings were also related to CE 6, but specifically in the Aerodrome and Ground Aids (AGA) area, related to aerodrome data, runway safety areas and runway incursion and collision avoidance.
- Furthermore, due to the forecasted increase in regional traffic, risk exposure of the States in the CAR and SAM Regions could be affected due to low EI in Air Navigation Systems (ANS) including Aerodromes and Ground Aids (AGA) areas.

3. Conclusions based on predictive information

- Information on LHDs captured in the CAR and SAM Regions during 2017 and 2018, determined the technical error satisfies the goal of not exceeding 2.5×10^{-9} fatal accidents per flight hour due to loss of standard vertical separation of 1,000 ft and all other causes.

4. Safety Intelligence correlations

- Accidents and their precursors, presented in the first part of the report, provide a perspective of the entire aviation system about safety. To manage safety in an efficient manner, it is important to maintain reliability in safety information and intelligence, which is only achievable by developing and improving safety data gathering, validation, exchange and analysis processes.

- Even though different stakeholders maintain their own initiatives for safety data collection and analysis, the development of safety reports could allow the aviation community to obtain a harmonized view of the aviation system. Stakeholders are encouraged to use ADREP, US CAST, ISARPs and other standardized taxonomies, which could facilitate addressing a shared comprehension of conditions and situations related to safety.

- Technological improvement in the aviation system requires fast and complete data exchange. In the age of intelligence, data availability is key to be up to date. Applied to safety, decision making on data transformed into information should support proper and timely response to key issues. Stakeholders are invited to use the areas showed in this Annual Safety Report to develop more in-depth analysis oriented to support the establishment of indicators, acceptable levels of safety and safety targets.

List of Acronyms

ADREP	Accident/Incident Data Reporting System (ICAO)
ADRM	Aerodrome
ARC	Abnormal Runway Contact
AFI	Africa (IATA Region) and Regional Aviation Safety Group-Africa-Indian Ocean (RASG-AFI)
AGL	Above Ground Level
AIG	Accident and Incident investigations
AIS	Aeronautical Information Service
AMAN	Abrupt manoeuvre
APAC	Regional Aviation Safety Group - Asia and Pacific Regions (RASG-APAC)
ARC	Abnormal runway contact
ARCM	AIG Regional Cooperation Mechanism
ASPAC	Asia/Pacific (IATA Region)
ASRT	Annual Safety Report Team
ATM	Air Traffic Management, Communications, Surveillance
ATS	Air Traffic Services
BIRD	Birdstrike
CAB	Cabin (IOSA)
CABIN	Cabin safety events
CAR	Caribbean (ICAO Region)
CARSAMMA	Caribbean and South America Regional Monitoring Agency
CEs	Critical Elements (ICAO)
CFIT	Controlled flight into terrain
CGO	Cargo Operations (IOSA)
CIS	Commonwealth of Independent States (IATA Region)
CMA	Continuous monitoring approach
CR	Conformance Report (IOSA)
CRM	Collision Risk Methodology
DGAC	Directorate General of Civil Aviation
DIPs	Detailed Implementation Plans
DSP	Dispatch (IOSA)
ECCAIRS	European Coordination Centre for Accident and Incident Reporting Systems
E-GPWS	Enhanced Ground Proximity Warning System
EI	Effective Implementation of ICAO SARPs
ESD	Electrostatic Sensitive Devices
EUR	Europe (ICAO and IATA Region) and Regional Aviation Safety Group - Europe (RASG-EUR)
EVAC	Evacuation
FDA	Flight Data Analysis
FDM	Flight Data Monitoring
FIR	Flight Information Region
FLT	Flight Operations (IOSA)
F-NI	Fire/smoke (none-impact).
FOQA	Flight Operations Quality Assurance
F-POST	Fire/Smoke (post-impact)
FUEL	Fuel related
GASP	ICAO Global Aviation Safety Plan
GCOL	Ground collision
GPWS	Ground Proximity Warning System
GRH	Ground Handling Operations (IOSA)
GSI	Global Safety Initiative
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICE	Icing
ICVM	ICAO Coordinated Validation Missions
IDISR	Data Exchange Program of Ramp Safety Inspections
IMC	Instrument meteorological conditions
IOSA	IATA Operational Safety Audit
ISARPs	IOSA Safety and Recommended Practices
ISTARS	ICAO Integrated Safety Trend Analysis and Reporting System
LALT	Low altitude operations
LAR	Latin American Aeronautical Regulation
LATAM/CAR	Latin America and Caribbean (IATA Regions)
LHDs	Large Height Deviations
LOC-G	Loss of control - ground
LOC-I	Loss of control - inflight
MAC	AIRPROX/TCAS alert/loss of separation/near miss collisions/mid-air collisions
MID	Regional Aviation Safety Group - Middle East (RASG-MID)
MNT	Aircraft Engineering and Maintenance (IOSA)
MENA	Middle East and North Africa (IATA Region)

MOU	Memorandum of Understanding
MTOM	Maximum Take-off Mass
NAM	North America (ICAO and IATA Region)
NASIA	North Asia (IATA Region)
OTHR	Other
ORG	Organization and Management System (ORG)
PA-RAST	Pan America – Regional Aviation Safety Team
RA	Resolution Advisory
RAIO	Regional Accident and Incident Investigation Organization
RAMP	Ground handling operations
RASG-PA	Regional Aviation Safety Group – Pan America
RASGs	Regional Aviation Safety Groups
RE	Runway excursion (departure or landing)
RI	Runway Incursion
RI-A	Runway Incursion – Animal
RI-VAP	Runway Incursion – vehicle, aircraft or person
RMA	Regional Monitoring Agency (CARSAMMA)
RVSM	Reduced Vertical Separation Minima or Minimum
SAM	South America (ICAO Region)
SARPS	Standards and Recommended Practices (ICAO)
SEC	Security Management (IOSA)
SEIs	Safety Enhancement Initiatives
SCF-NP	System/component failure or malfunction (non-powerplant)
SCF-PP	Powerplant failure or malfunction
SEC	Security-related
SIMS	ICAO Safety Information Monitoring System
SMS	Safety Management System
SOP	Standard Operating Procedure
SRVSOP	Regional Safety Oversight Cooperation System
TCAS	Traffic Collision and Avoidance System
TCAS RA	Traffic Collision and Avoidance System-Resolution Advisory
TEM	Threat and Error Management
TLS	Target Level of Safety (RVSM)
TURB	Turbulence encounter
UNK	Unknown or Undetermined
US CAST	Commercial Aviation Safety Team (United States)
USOAP	Universal Safety Oversight Audit Programme
USOS	Undershoot/Overshoot
WSTRW	Wind shear or thunderstorm

CREDITS – CRÉDITOS

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