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Agenda Item 23: Global Aviation Safety and Air Navigation Plans

AN ENHANCED DATA DRIVEN APPROACH TO IDENTIFYING GLOBAL OPERATIONAL SAFETY RISKS

(Presented by Singapore, co-sponsored by New Zealand, Flight Safety Foundation, and International Federation of Air Line Pilots' Associations)

EXECUTIVE SUMMARY

This working paper addresses a fundamental challenge in the development and implementation of the Global Aviation Safety Plan (GASP); the limited availability of comprehensive safety data, particularly regarding precursor events to accidents and serious incidents for comprehensive risk analysis. While the GASP emphasises data-driven decision making, current safety analysis relies heavily on accident data, with incomplete coverage of serious incidents and limited systematic collection of precursor event data at the global level.

To address this gap, the paper proposes a simplified mechanism for collecting and sharing safety information through standardised occurrence rates, enabling States to share meaningful safety data while protecting sensitive information through anonymisation and aggregation. This solution requires minimal additional resources, integrates with existing processes, and provides a practical pathway to enhancing data-driven safety information while addressing States' concerns with data confidentiality and protection.

Action: The Assembly is invited to:

a) discuss the extent to which incomplete precursor event data may affect the effectiveness and evidence-based development of the GASP;
b) agree on the need for the appropriate ICAO expert group to consider:
    1) the proposed mechanism of identifying precursor events and collecting de-identified occurrence rates at the regional level as a means to enhance data-driven safety planning; and
    2) evaluate how the proposed mechanism could improve understanding of the current safety state and enable better measurement of GASP, RASP, and NASP effectiveness.

Strategic Goals:	This working paper relates to *Every Flight is Safe and Secure.*
Financial implications:	Nil
References:	Doc 10004, *2020-2022 Global Aviation Safety Plan*

1. INTRODUCTION

1.1 The Global Aviation Safety Plan (GASP) presents the global strategy for the prioritisation and continuous improvement of aviation safety. Key additions to the GASP 2026 - 2028 edition included the identification of abnormal runway contact, system/component failure or malfunction (non-powerplant) and turbulence encounter as global operational safety risks as they feature prominently in the most frequent accident and serious incident types across all ICAO regions. The identification of these additional global safety risks reinforces the importance of adopting a data-driven approach in decision making and planning in aviation safety.

1.2 The limited availability of safety data has posed challenges in identifying and examining safety risks comprehensively. In order to accurately identify global safety risks and measure the success of the GASP, there is need to systematically collect, analyse and share data on precursor events related to the global high-risk category of occurrences (G-HRCs) and the other global risk categories of occurrences.

1.3 This working paper examines some of the challenges in collecting data on precursor events globally and proposes measures to better support the data-driven approach that underpins the GASP's objectives. The proposed approach also aligns with and strengthens the Regional Aviation Safety Groups' (RASGs) abilities to fulfil their stipulated roles in regional safety data collection and analysis.

2. DISCUSSION

Challenges in sharing precursor data globally

2.1 Assembly Working Paper A40-WP/213 set out the progress made by regional safety data sharing initiatives worldwide. The paper also presented challenges such as the need for robust data governance, the need to build trust and confidence in the use of data, and the availability of resources to administer the sharing of such data.

2.2 While some of these challenges require longer term solutions, small initial steps can be taken to enhance the collection and sharing of safety data globally, including by States who have yet to fully establish their safety data collection and processing system (SDCPS).

Proposed elements of the enhanced the sharing of precursor data

2.3 ***Identify risk category precursor events.*** Taking reference from A41-WP/306 regarding a standardised set of safety performance indicators and other global and regional data sharing programmes, the following table presents an initial list of potential precursor events that could be monitored and analysed to identify global operational safety risks.

Table 1 – Potential precursor events

Risk Category	Potential Precursor Events to Monitor[1]
Controlled Flight Into Terrain (CFIT)	• Activation of Ground Proximity Warning System (Modes 1 - 4)
Loss of Control In-Flight (LOC-I)	• Low speed / stall warning or protection activation • Windshear • Wake turbulence
Mid-Air Collision (MAC)	• Traffic Collision Advisory System Resolution Advisory (TCAS-RA) / Loss of separation events
Runway Excursion (RE)	• Unstabilised approaches that continue to land
Runway Incursion (RI)	• Runway Incursions[2] • Taxiway Incursions/Errors
Turbulence Encounter (TURB)	• Severe turbulence encounter
Abnormal Runway Contact (ARC)	• Landings outside the touchdown zone • Hard landings
System/Component Failure or Malfunction (non-powerplant) (SCF-NP)	• System/Component Failure or Malfunction (non-powerplant)[3]

2.4 The potential precursor occurrence categories are restricted to event types that are less subjective in nature. Even where regional or State differences exist, the data is still valuable because the outcome remains relevant (for example, differences in unstabilised approach criteria exist but the data remains valid as the unsafe outcome is the same). It is also acknowledged there are circumstances where double counting of events may occur (for example both an air operator and an aerodrome operator may report the same incursion event). Given the scale of the dataset, such factors are unlikely to significantly effect the representative value of the data. This list is intended to be dynamic and can be refined through consultation with relevant ICAO panels and regular reviews by the GASP Study Group (GASP-SG).

2.5 ***Normalise the precursor event data.*** To provide comparable data, it is necessary to convert absolute count of events into standardised rates. This approach effectively addresses data sensitivity concerns by eliminating the need to share specific occurrence details. An example of the calculation on severe turbulence encounters is shown below:

$$\text{Rate} = (\text{Number of severe turbulence encounters}) / (\text{Total flight hours/flight cycles}^4 \text{ by air operators within the State}) \times K$$

Where K represents a standardisation factor (e.g., per 1,000, 10,000, or 100,000 flight hours)

[1] Event descriptors shown in plain language for discussion purposes; subsequently precursor events should be aligned with ICAO CAST taxonomy for standardisation

[2] Runway incursions that did not result in accident and serious incidents.

[3] SCF-NP occurrences of critical systems that did not result in accident and serious incidents.

[4] The denominator value is to be determined by the precursor category, e.g. Number or Loss of Separation/Flight Hours but Number of Unstabilised Approaches continued to land/Flight Cycles

2.5.1 This standardised rate-based approach provides meaningful safety performance data while protecting sensitive information.

2.6 ***Aggregate rate data at a regional level.*** Data governance principles and robust data confidentiality and protection protocols are critical to build trust in the sharing of data. To address any concern on data confidentiality, it is proposed that States/Administration submit the safety data to the Regional Offices. This arrangement serves multiple purposes:

a) supports regional safety initiatives and planning;

b) informs the work of Regional Aviation Safety Groups (RASGs);

c) guides Regional Aviation Safety Teams (RASTs); and

d) provides data for Planning and Implementation Regional Groups (PIRGs)

2.7 To further enhance data protection and provide meaningful global insights, the ICAO Regional Offices would aggregate individual State rates into consolidated regional rates. These regional rates would then be provided to the Air Navigation Commission (ANC) to inform the work of the GASP Study Group, enabling:

a) trend analysis at the regional level;

b) evidence-based development of future GASP editions;

c) more effective and targeted safety enhancement initiatives; and

d) monitoring of the effectiveness of the GASP

2.8 This multi-layered approach to data collection and aggregation ensures both data protection and meaningful safety analysis at State, regional, and global levels.

Advantages and benefit

2.9 The proposed rate-based approach to risk category precursor event monitoring offers a practical and efficient solution to enhance data-driven safety planning while addressing concerns about data confidentiality and protection. This methodology provides several distinct advantages:

a) Simplicity and efficiency:

1) utilises existing State safety monitoring processes;

2) requires minimal additional resources from States;

3) integrates seamlessly into current ICAO workflows[5];

4) does not require amendments to ICAO's work programme;

b) Data confidentiality and protection:

1) achieves anonymity through aggregation;

[5] Relating to existing workflows in GASP development and safety information sharing between regions and ICAO

2) eliminates sharing of sensitive operational details;

3) protects operator, aircraft, and personnel information;

c) Statistical robustness:

1) accounts for variations in traffic volume between States and regions;

2) remains statistically valid even with occasional gaps in submission;

3) provides meaningful trending data despite periodic fluctuations;

4) enables valid comparisons across regions of different sizes;

d) Strategic value:

1) informs evidence-based development of RASPs and the GASP;

2) supports proactive identification of emerging safety trends;

3) enables more targeted safety enhancement initiatives; and

4) provides quantifiable metrics for safety performance monitoring

3. CONCLUSION

3.1 This proposed methodology represents a balanced approach that addresses the critical need for global safety data while respecting the practical constraints and data confidentiality and protection concerns of States. By focusing on rates rather than raw data, it provides a sustainable framework for long-term safety monitoring that can evolve with the industry's needs while maintaining its fundamental simplicity and effectiveness.

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