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Agenda Item 6: Progress on Regional and National air navigation planning

PROGRESSIVE DEVELOPMENT OF CAPABILITIES IN ADVANCED ANALYTICS AND ARTIFICIAL INTELLIGENCE FOR THE PROCESSING OF KEY PERFORMANCE INDICATORS (KPIs) AND EARLY RISK DETECTION IN AIR TRAFFIC SERVICES

(Presented by Mexico)

EXECUTIVE SUMMARY

The continuous improvement of air traffic services (ATS) requires performance measurement and analysis systems that are timely, reliable, and able to reflect the complexity and dynamics of today's operations. Key performance indicators (KPIs), when properly designed and processed, make it possible to assess not only safety aspects, but also efficiency, capacity, punctuality, workload, and sustainability.

However, many States and air navigation service providers face significant constraints: data fragmentation, manual or semi-automated processes, low analysis periodicity, and difficulties in extracting useful information in changing operational contexts. These challenges reduce the usefulness of KPIs as tools for strategic and tactical decision-making.
This Study Note proposes a progressive approach to strengthen technical capabilities through the use of advanced analytics and artificial intelligence (AI), as tools to support the development, processing, and use of ATS KPIs.

This approach does not seek to replace existing processes, but rather to complement them by increasing the ability of current systems to identify patterns, anticipate deviations, and support data-driven decisions across multiple dimensions of operational performance.

It is proposed that this transformation process be implemented in a structured and gradual manner, respecting principles of governance, ethics, traceability, and human oversight, and aligned with ICAO guidance and frameworks.

Action:	a) Encourage States and air navigation service providers in the CAR/SAM Region to strengthen their KPI-based performance frameworks, ensuring that KPI design, processing, and use follow the principles of Annex 19, Doc 9859, and the GASP, while considering the progressive development of advanced analytics and AI capabilities as technical support, where feasible; and,

	b) Request an analysis of the advisability of developing specific regional guidance on the use of these tools to support the development, analysis, and use of operational safety KPIs in ATS operations.	
Strategic Goals 2026–2050:	**By 2026** Establish regional technical guidelines for the use of AI and advanced analytics in KPI processes. **By 2030** Achieve partial automation of KPI consolidation, validation, and analysis processes in most States. Integrate early detection capabilities for adverse trends and predictive alerts as part of the SSP and SMS. **By 2035** Ensure that all States in the CAR/SAM Region have fully automated KPI frameworks, with predictive analytics capabilities under human oversight. Consolidate an interoperable regional network to share, compare, and harmonize KPI-based operational performance.	
References:	• Annex 19 • Doc 9859 Doc 9906 • Doc 4444	• Doc 8126 • Doc 10004 • Doc 9750

1. Introduction

1.1 Operational growth in air traffic services (ATS) requires the systematic use of key performance indicators (KPIs) that allow the measurement, monitoring, and anticipation of an acceptable level of risk. Foundational documents such as Annex 19, Doc 9859, and the GASP (Doc 10004) establish that performance-based management should be grounded in information that is reliable, timely, and actionable.

1.2 However, increasing operational complexity and the volume of generated data pose significant challenges for States and air navigation service providers, particularly with respect to the development, processing, and effective use of KPIs. This Study Note proposes the progressive development of advanced analytics and artificial intelligence (AI) capabilities as technical support tools—not substitutes—across the KPI life cycle within the SMS and SSP framework.

2. Background

The CAR/SAM Region has advanced in the adoption of performance frameworks, including GREPECAS and RASG-PA initiatives to establish regional indicators. Nevertheless, critical challenges remain:

- Manual or fragmented processing of data from multiple sources (surveillance, ATS reports, operational conditions).
- Difficulties in detecting emerging patterns or adverse trends with sufficient anticipation.
- Limited automation in KPI integration, analysis, and visualization.
- Low periodicity and/or limited agility in using indicators for strategic and operational decision-making.

Traditional approaches are being outpaced by the demands of proactive risk management. Globally, AI algorithms and analytical tools have begun to be incorporated to extract value from large volumes of data, thereby improving predictive and response capabilities.

3. Discussion

3.1 The progressive use of advanced analytics and artificial intelligence can strengthen ATS performance management through the following benefits:

- Automation of routine processes, such as consolidation, cleansing, and calculation of indicators.
- Early identification of operational deviations, atypical patterns, and emerging events.
- Contextual correlation of operational data with external conditions (weather, traffic demand, sector configuration).
- Improved traceability, accuracy, and agility of operational safety decision-making

3.2 These tools should be implemented under clear governance, with human oversight and principles of ethics and traceability, consistent with ICAO promotion. The objective is not to replace processes, but to enhance their analytical and predictive capability.

3.3 In addition, adoption should follow a maturity logic: starting with basic automation and evolving toward predictive capabilities, always aligned with each State's operational needs.

4. Suggested Actions

4.1 At the level of States and service providers:

- Strengthen KPI-based performance frameworks in accordance with Annex 19 and Doc 9859.
- Progressively develop advanced analytics and AI capabilities as support tools for KPI design, processing, and analysis.
- Integrate these tools into processes, ensuring quality, traceability, and governance of results.

4.2 At the regional level (GREPECAS):

- Promote KPI harmonization and comparability among States through common criteria.
- Foster the exchange of good practices and experiences in automation and operational safety analytics.
- Initiate the development of regional guidance material on the use of advanced analytics and AI for the treatment of KPIs in ATS.

5. Conclusions

5.1 Effective operational safety management in air traffic services depends largely on the ability to develop, process, and use KPIs that accurately reflect the state and evolution of the system. However, current limitations related to data volume, fragmented sources, and manual or semi-automated processes reduce the agility, accuracy, and usefulness of these indicators for timely decision-making.

5.2 The progressive development of advanced analytics and artificial intelligence capabilities represents a strategic opportunity to strengthen the KPI life cycle without substituting professional judgement or established processes. These technologies can facilitate data integration, contextual analysis, identification of emerging patterns, and generation of predictive alerts, improving anticipation of and response to operational risks.

5.3 Their incorporation, however, requires a structured, gradual, and ethical approach, aligned with ICAO guiding principles and adapted to each State's operational realities. The CAR/SAM Region has the opportunity to advance in a coordinated manner toward smarter, collaborative, and data-driven performance management that reinforces operational safety and ATS efficiency.

5.4 Therefore, it is necessary for the regional bodies to consider the formulation of specific guidance and the establishment of common goals that facilitate the harmonized adoption of these technologies, as part of the continuous improvement and evolution of the regional air navigation system.

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