INTERNATIONAL CIVIL AVIATION ORGANIZATION

Twenty-Seventh Meeting of the AFI Planning and Implementation Regional Group (APIRG/27)

5 to 6 November 2024

Agenda Item 3: Implementation of air navigation goals, targets and indicators, including the priorities set in the Regional Air Navigation Plan

3.6. Other Air Navigation Initiatives

Introduction of Automation and Artificial Intelligent (AI) into the AFI Air Traffic Management (ATM) System

(Presented by South Africa)

SUMMARY
This working paper presents the requirements for the introduction of enhanced Automation and Artificial Intelligence (AI) within the AFI Region in the ATM System.   Actions by the Meeting is provided in Paragraph 3 of this paper.

Strategic Objectives	A – Safety, B – Air Navigation Capacity and Efficiency, D – Economic Development of Air Transport, and E – Environmental Protection.

1. **INTRODUCTION**

1.1   The United Nations projects that by 2050, the Population of the AFI region will reach close to 2.5 billion. Airbus further predicts that air traffic in the African region will double during the period from 2027 until 2043, with African airline fleets growing by 2.8 times during the period (Times Aerospace, 16-Sep-2024). The company forecast African airlines will require approximately 1460 new aircraft (83% narrowbodies and 17% widebodies) from 2024 until 2043, necessitating 15,000 new pilots.

1.2   To address this growing demand for air travel, it requires the enhancement of the ATM system in order to balance demand against available capacity. Capacity enhancements on infrastructure such as Airports and Airspace will also eventually reach saturation, which require an innovative and agile approach in creating additional capacity.

1.3   The introduction of new airspace entrances and the push towards net zero Carbon emission by 2050, calls for the aviation industry to explore other initiatives to optimize the Air Traffic Management (ATM) system and to revolutionize technology to meet the predicted demand.

1.4   The future of ATM systems will rely increasingly on automation, AI and Human Machine collaboration to safely manage the growing diversity, density, and environmental considerations.

2.   DISCUSSION

2.1   Technology and society change more quickly than some organisations can adjust, making it difficult for industries to adapt to the changes. Innovation is essential to altering the current situation; it makes the difference between merely surviving and flourishing in your surroundings.

2.2   Process automation in data management has brought attention to the fact that more data is being gathered from a variety of sources at a faster rate in a dynamic and constantly evolving technological environment. This data needs to be consolidated and validated; it is too much for a human to handle manually using conventional methods (information overload).

2.3   Automation was first applied in ATM in the 1950s for data sharing ((flight plans, Notice to Airman (NOTAMs), estimations, etc.)). More activities were performed by machines after computers were introduced in the 1970s, leading to the development of automated ATM systems. The process is continuous and is fueled by the demand for traffic on the one hand, and the quick advancement of technology (systems, software and computers) on the other.

2.4   AUTOMATION

2.4.1   Automation means operating equipment with minimal or reduced human intervention.

2.4.2   There are three major areas where automation can improve the ATM system.

2.4.3   **Information exchange** - this is the first field where automation is used in the ATM System. and is also the most well-developed one due to the internationally standardized rules.

2.4.4   **Safety tools** - these are mostly intended to help with conflict identification and to mitigate human error.

2.4.5   **Efficiency tools** - these are usually intended to help the controller with the planning process.

2.5   LEVELS OF AUTOMATION

The introduction of Automation into the ATM system should be guided by the existing automation levels and the technology maturity of the region. The automation levels include the following:

2.5.1   Human **Within** the Loop (HWTL): Human is always in direct control of the systems and has freedom of choice and ability to impact the behaviour of the system.

2.5.2   Human **On** the Loop (HOTL): The human operator oversees the autonomous operations but does not directly control the system and can intervene if necessary. Example: Remotely Piloted Aircraft Systems, where the pilot could take control remotely. The human has time to decide to engage with the system and alter its behaviour.

2.5.3   Human over-the-Loop, strategic and exception centric: This level of automation involves

strategic oversight rather than direct operational control. Here, the human's role is to manage and resolve exceptions in a system where machines primarily control other machines. The human has sufficient situation understanding.

2.5.4   Human Out of the Loop (HOOTL): In this level of automation, the system operates entirely independently without any human intervention in its daily operations. Humans are not involved in real-time decision-making or operational control. However, it's important to note that humans are responsible for defining the performance levels and safety parameters within which the system must operate autonomously. The human is capable to predict the behaviour of the system and the effects of the environment.

2.6   ARTIFICIAL INTELLIGENCE

2.6.1   **Artificial Intelligence (AI)** The ability of machines to perform tasks that normally require human intelligence, such as learning, reasoning, and decision-making. AI has the potential to radically change our industry by enhancing safety, improving efficiency, and allowing us to do that while accommodating the demands of future air traffic growth.

2.6.2   **AI** can complement and augment human capabilities by enhancing decision-making (providing data-driven insights for informed decisions by analyzing vast data in real time) and automating repetitive tasks focusing humans on complex.

2.7   LEVELS OF ARTIFICIAL INTELLIGENCE (AI)

AI as a contributing factor, will enhance automation by improving the identification of patterns and making predictions, automating manual processes and increasing productivity. The levels are as follows:

2.7.1   **(Level 1-5)**
Manual or Human-Controlled Automation Foundational level with human control; automation supports tasks, reduces workload, but doesn't make autonomous decisions.

2.7.2   **(Level 5-7)**
Assisted or Supervised Automation) Intermediate level where automation operates autonomously under human supervision.

2.7.3   **(Level 8 -10)**
Autonomous Automation Leading to Artificial Intelligence Advanced level where automation can make independent decisions based on data and rules

2.8   BENEFITS OF AUTOMATION and AI.

2.8.1   **Safety-** Enhancing overall safety by providing better support for all types of operations, improving the human-machine interface, and increasing situational awareness.

2.8.2   **Capacity-** Managing higher volumes of air traffic with greater efficiency and safety.

2.8.3   **Environment -** Automation's role in minimizing environmental impact through optimized routing and operations.

2.8.4   **New Entrants-** Integrating new types of air vehicles, such as drones and electric vertical

take-off and landing (eVTOL) aircraft, into the airspace.

2.9   Identification of automation levels required within the ATM system of the AFI Region supported by artificial intelligence would drive significant benefits to the ATM system operations in terms of safety, efficiency and environmental sustainability. It is therefore critical that the AFI Region prioritise the adoption of Automation and AI into the ATM System in the AFI Region, through the review, identification and advancement of AAO and IIM projects, as aligned to Global Air Traffic Management Operational Concept (GATMOC – Doc 9854) and Global Air Navigation Plan (GANP – 9750).

3.   ACTION BY THE MEETING

3.1   The meeting is invited to:

3.1.1   Take note of the information and the benefits that can be derived from implementation of automation and AI within the ATM system of AFI Region.

3.1.2   Support the establishment of a project Team to identify and integrate automation and AI into AFI ATM Masterplan.

APIRG/27 Decision xx/xx: Establishment of the ATM system automation and AI Project Team

That, considering the impact of automation and artificial intelligence on ATM system within the AFI Region, and to ensure globally harmonised and interoperable ATM system for the AFI Region that:

a) The APIRG Airspace and Aerodrome Operations Sub-Group (AAO/SG) and Infrastructure and Information Management Sub-Group (IIM/SG) to coordinate the establishment of ATM system automation and an AI Project Team which includes technical experts from States, ANSPs, Airspace users and other concerned international organizations by xx February 2025; and

b) The Project Team to identify requirements for ATM system automation and AI integration within AFI Region ATM system.

c) The requirements to be included into the AFI ATM Masterplan.