Twenty-Fourth Meeting of the AFI Planning and Implementation Regional Group (APIRG/24)
(Virtual – 2 to 4 November 2021)

Agenda Item 7: Any Other Business

Title AFI Research, Development and Innovation (RDI) in Aviation

(Presented by South Africa.)

SUMMARY
This working paper provides the digital technologies opportunities and challenges; calls attention to Air Traffic Management (ATM) community in terms of the ICAO Global ATM Operational Concept (Doc 9854)[1] to embrace digital technologies, early consultations and engagements to develop strategic approach in ATM research, development and innovation (RDI) to assist with Implementation of ASBU Modules and other AFI Operational requirements. **Action:** As recommended in Par. 4
REFERENCE(S): 1. 40th Assembly Session - Resolution 26/2 (Doc 10136, A40-EX) 2. 13th Air Navigation Commission (ANC) Report, Doc 10115 3. IIM SG 4 Report

Strategic Objectives	Safety; Air Navigation Capacity and Efficiency; Security & Facilitation; Economic Development of Air Transport; and Environmental.

1 INTRODUCTION

1.1 The world is on the brink of a technological revolution that alter the way we work, live, and relate to one another. The future will look different due to digital technology disruption. The AFI Region should be committed to prepare for the technological world.

1.2 Innovation is critical for the sustainability and survival of various entities in the future. Innovative and creative thinking are elemental for solving various problems that the industry might face either currently or in the future as well as assisting organizations to be agile and efficient in their daily operations. Hence, as an effort for organizing, structuring and managing

[1] ATM Community: The aggregate of organizations, agencies or entities that may participate, collaborate and cooperate in the planning, development, use, regulation and maintenance of the ATM system (ICAO Doc 9854, Appendix A refers).

innovative solutions, the AFI Research, Development and Innovation (RDI) is a crucial requirement.

1.3 RDI enables organizations to maintain their viability and competitiveness in a rapidly evolving aviation industry. Research answers many of the questions that face the organization in its challenge to remain sustainable and grow.

1.4 The opportunities of digital technologies like Artificial Intelligence (AI); Remote Services – Digital Towers; Service oriented architecture (SOA), Software as a Service (SaaS), Infrastructure as a service (IaaS) or Platform as a service (PaaS); Augmented Reality (AR)/Virtual Reality (VR) and others; have the potential to accelerate the ATM enhancement goals of improving efficiency, safety; and reliability of service.

1.5 These goals can be achieved through collaboration of researchers, academia, industry, regulator and other stakeholders.

1.6 This working paper provides the digital technologies opportunities and challenges and calls attention to Air Traffic Management (ATM) community to embrace digital technologies, early consultations and engagements to develop strategic approach in ATM research, development and innovation (RDI) to assist with Implementation of ASBU Modules and other AFI Operational requirements.

2 DISCUSSION

2.1. The ICAO 40th Assembly Session - Resolution 26/2 (Doc 10136, A40-EX), urged all Member States that have experience in facilitating the introduction of innovation in civil aviation, and that have evolved their regulatory methods to better evaluate and assess the application of such innovations, to share their experience with other States through ICAO.

2.2 The future South African Air Navigation plans is to consider concepts such as global aeronautical distress and safety systems (GADSS), big data, Internet of Things (IoT) and a global aviation internet network. It is crucial that the aviation industry take timeous action to monitor and evaluate these developments in a manner that does not leave AFI States behind.

2.3 These technologies are rapidly becoming available across the aviation sector and can lead to more efficient and streamlined aviation processes. There has been increased use of machine learning, artificial intelligence and blockchain in applications developed for aviation which have similar effects for other sectors like banking, health, agriculture, etc. The digital technologies promise to result in improved optimization, efficiency, capacity and more safety, and adaptability to all aviation stakeholders.

2.4 Artificial Intelligence

2.4.1 Artificial intelligence is for everyone. The ability to learn, improve and predict is the distinguishing factor of an AI system from a traditional software system. The AI system can produce new knowledge based on training and use to new situations. Aviation is faced with uncertainties, operational changes and skills shortage. But the industry can exploit the use of AI to address the current challenges and empower the industry with the ability of quick decision making and provision of procedures that simple algorithms may not provide.

2.4.2 The outputs of artificial intelligence (AI) has already been consumed without realizing it; with the new technological inventions and applications or think about the technology behind the AI-powered devices that we use every day. The engine of AI technology is the algorithm, and algorithms are at work every second. Devices and systems that most of us use, including smartphones, email and search engines are infused with different algorithms. The AI technology transforms the future of work including the required skills and knowledge.

2.4.3 South Africa (ATNS) has initiated a research project to develop AI-based application for the ATM community. The ATNS research team is developing an artificial intelligence solution that uses speech recognition technology that would effectively prevent Runway Incursions by alerting tower controllers of impending conflicts called ROAST (Runway Occupancy Alert System).

2.4.4 South Africa experiences approximately 6 Runway Incursions (RI) per year. The risk rating associated with these runway (RWY) incursions is usually high, falling into category A (i.e. a serious incident in which a collision was narrowly avoided) and B (i.e. an incident in which separation decreases and there is a significant potential for collision, which may result in a time critical corrective/ evasive response to avoid a collision) events. Runway incursions normally have a high-risk rating because of the small window of opportunity available to either the Air Traffic Controller (ATC) or Pilot for error correction.

2.5 **Potential Benefits of Artificial Intelligence**

2.5.1 Increased decision-making capabilities within complex and uncertain environments, using predictions with less or no information. This will greatly assist with human error especially during traffic and airspace changes.

2.5.2 Applied to speech recognition to act as a safety net; foreseen as an essential tool that will be integral to future ATM operations.

2.6 **Computer Vision**

2.6.1 Aerodrome traffic or ground movement at some airports are controlled by the use of the Surface Movement Radar as a detector/ sensor and as well as the use of ASMGCS as a modular system for routing, guidance, support safety and surveillance. The use of ASMGCS as effective as it is, is costly for use small airports considering the little revenue generated in those small airports. But as small as these airports are, safety is paramount there too. Computer Vision is an interdisciplinary scientific field that deals with how computers can gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to understand and automate tasks that the human visual system cannot do.

2.6.2 South Africa (ATNS) is currently working on RATS - Digital Towers project with the Computer Vision to be used as the enabling technology for part of the Visual Surveillance System that is responsible for identifying objects captured from the high-resolution tower cameras and sensors situated in and around the aerodrome.

2.7 **Potential Benefits of Computer Vision**

2.7.1 Computer Vision seeks to enhance the surveillance capabilities of an aerodrome, making it easier for Air Traffic Controllers to identify objects on the aerodrome and make informed decisions.

2.7.2 Computer Vision has also been identified as a key technology that may be of significance to the surveillance techniques to be used in the Remote Air Traffic Service (RATS) digital Towers programme.

2.7.3 To manage aircraft and vehicle traffic/movements in the aerodrome or maneuvering area. Its use in air traffic management could be to assist in decision making, especially in the future ATNS remote towers or standard towers.

2.8 **Machine Learning**

2.8.1 Machine learning is a branch of artificial intelligence that uses data to make different predictions, focuses on adaptive systems that continuously learns from human interaction and adapts to increase performance.

2.8.2 South Africa (ATNS) has been looking at the use of machine learning to automatically measure the workload of area controllers. A project was started in collaboration with an Original Equipment Manufacturer (OEM) where the eye-tracking technology is used to quantify the workload and use situational analysis to predict the controller actions.

2.8.3 The benefits of machine learning lie in the ability to automate mundane and repetitive tasks to free up the controllers to focus on more safety critical tasks. This will greatly decrease controller workload and potentially improve safety and efficiency of operations.

2.9 **Blockchain**

2.9.1 Blockchain technology is a distributed ledger technology that is used to improve transactional security. A normal ledger is a log of transactions that can capture how transactions are completed, e.g. banking users would log into a banking app and transfer money from one account to another. Transactional logging would include when the user logged in, the balance when the user logged in, when the user transacted to transfer the money, how much money was transferred, how much money was left after transfer and update the account to which the money was transferred to.

2.9.2 Transactional ledgers are susceptible to malicious editing. Blockchain replicates the ledger and stores it across the network of users and continuously synchronizes and compares the ledgers. Any malicious edits to the ledger are then easily traced and audited. ATNS, and other aviation stakeholders, are researching blockchain technology to keep a distributed ledger in the sharing of aeronautical information. GADSS, ATS Interfacility Data Communication (AIDC) and System Wide Information Management (SWIM) require more sharing of operations information across aviation stakeholders. Blockchain is being researched as an information security technique.

2.10 **Information and Data Management**

The capturing, storing, structuring, labeling, accessing and understanding data to build the foundation and infrastructure is key to work with digital technologies. Also, the value of data needs to be understood and prioritized; define data governance and strategy; and build the data structure to embrace unstructured data within AFI region.

2.11 **Funding**

The trend in several industry sectors is reduction in spending in the area of RDI. This reduction appears to be in the business plans of both private industries, research agency, universities and many publicly funded organizations. There is a strong focus on developing business plans to deliver short to medium returns. This reduces the priority of allocating resources to strategic and long term needs of the business. The RDI budgets are seeing the effect of this trend. Motivating for RDI budget is becoming difficult in many organizations, may be because is seen as resources wasting rather than investments. However, to remain relevant and competitive in the aviation sector, AFI needs to continue with RDI despite the limited funding.

2.12 **Leadership**

2.12.1 The ability to lead a transformation that leverages the digital technology to set defined goals, capture business value and achieve broadly based internal and external buy-in by an organization is a crucial requirement. The organizational transformation driven by the digital technologies will be continuous. This requires seeing AI as a process and not a project. Leadership needs to be accustomed to digital technologies to understand how it will affect the company. Articulating a clear digital transformation vision is key to achieving buy-in and motivating exploration of use-cases with uncertain outcomes.

2.12.2 Creating an open culture in which people embrace change, work to break down silos, and collaborate across the organization and with external parties will need to be adopted. There's a requirement to establish cross State projects to foster collaboration and learning across functions; to ensure the employee buy-in by being open and clear about on-going projects and desired outcomes; and to ensure that governance structures support collaboration through projects co-owned by relevant experts and business leaders.

3 Impact of COVID-19

3.1 The COVID-19 pandemic is a huge risk not only to the sustainability of AFI States but also the implementation of the AFI strategic objectives.

3.2 One of the impacts of the COVID-19 pandemic is the need for financial reconsideration and a reduction of operating budgets. This has prompted the focus on the development of new products that can be done inhouse or in collaboration with current industry partners.

3.3 This requires an agile development environment, an experimental approach in which collaborative, cross-functional teams work in short project cycles and iterative processes to effectively advance solutions. Agile development has been considered effective in engaging people across functions, fostering collaboration, and bridging tech and business; it promotes

quick internal learning due to their frequent feedback loops; and quick to realize the benefits with pilot projects and case testing.

4 Collaborations/Partnerships:

4.1 There is a requirement to leverage on collaborations with other organizations such as Universities, Research Institutions/Agencies, Original Equipment Manufacturers (OEM), Government departments and State Own Enterprises (SOE) due to lack of resources.

4.2 APIRG should embark on a process to develop a strong RDI competency that is able to support operational needs and produce new solutions for commercialization. The strategic importance of this will be realized once incorporated in the APIRG activities and further broken down into the APIRG RDI Implementation Plans.

5 Funding

5.1 The RDI project funding can allow States to advance the AFI position, through research activities by developing innovative roadmaps agile enough to change based on user requirements, identifying cutting edge technologies within ATM environment and inventing new possibilities through product, process and services development and/or improvement.

5.2 The lack of RDI project funding could possible impede the company's ability to exploit the opportunities related to the innovation space with the possibility of creating intellectual property (IP).

5.3 Researchers or innovators need to spend less time sourcing funding and use most of the time doing research and/or innovation. Funding is the core mechanism behind the innovation system, that will provide the required resources to create new knowledge or enhance existing knowledge. There are numerous possible coordination and collaboration that can be established between institutions that can assist with funding per development stage and gain access to various grants and incentives.

6. Conclusion

6.1 The 40th Assembly urged all Member States that have experience in facilitating the introduction of innovation in civil aviation, and that have evolved their regulatory methods to better evaluate and assess the application of such innovations, to share their experience with other States through ICAO.

6.2 There is a need to align research amongst the AFI States aviation stakeholders to prepare for the future; share relevant experiences so that members are aware of the potential benefits. This will allow AFI to share with other Continents as per A40 Resolution 26/2.

6.3 A greater research collaboration is required within the ATM community because as the technology evolves, it becomes difficult to develop the technical depth to evaluate and facilitate the introduction of the technologies. Therefore, a practice to share the experience, expertise and best practice to support the introduction of new technologies; and co-develop rules.

6.4 Therefore, there's a need for APIRG, its auxiliary body and the ATM community

subject matter experts to consider the following in their respective areas:

6.4.1 Develop the AFI RDI Strategy and Framework; it is important to recognize the need for, and endorse the development of a framework which is not technology specific but can be used to evaluate innovations in a timely manner;

6.4.2 Monitor RDI in aviation;

6.4.3 Identify AFI strategic RDI programmes aligned with AFI State operational requirements;

6.4.4 Foster innovation and extend participation to other technological disruptors in other industries;

6.4.5 Facilitate the sharing of information and RDI by the AFI State aviation community;

6.4.6 Intellectual Property (IP) Management;

6.4.7 Translate ideas into commercialization and ensure commercialization is achieved;

6.4.8 Source RDI funding; and

6.4.9 Conduct cost benefit analysis of new RDI technologies aligned with user/operational requirements.

7 ACTION BY THE MEETING

7.1 The meeting is invited to:

a) note the contents of this paper;
b) support the proposed tasks listed in Par 6.4; and
c) adopt the draft Decision in 7.2.

7.2 **Draft Decision 4/xx : Title of Decision**

Incorporation of Research, Development and Innovation (RDI) in APIRG work programme

That

a) The work programmes of APIRG and its auxiliary bodies be amended to include activities related to Research, Development and Innovation (RDI), in order to assist AFI States in addressing the implementation of operational requirements and ASBU modules elements;
b) Establish the AFI RDI Forum.

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