



## **THIRTEENTH AIR NAVIGATION CONFERENCE**

**Montréal, Canada, 9 to 19 October 2018**

### **COMMITTEE A**

#### **Agenda Item 3: Enhancing the global air navigation system**

##### **3.3: Air traffic flow management (ATFM)**

### **DETERMINATION OF REAL TIME ATC SECTOR WORKLOAD USING NEURAL NETWORKS**

(Presented by India)

#### **EXECUTIVE SUMMARY**

This paper presents the overview of an exploratory research approach by the Airports Authority of India (AAI), a major air navigation services provider (ANSP) in the Asia Pacific (APAC) Region, wherein a combination of fast-time simulation, historic-data analysis and neural networking may provide an ideal solution for the complex air traffic control (ATC) sector work load determination compared to the conventional methods and their obvious limitations.

**Action:** The Conference is invited to:

- a) note the approach by AAI based on neural networking for determining ATC sector workload on a dynamic basis and
- b) impress upon states to share their approaches on the subject to enable ICAO to standardise the solution for determining dynamic ATC sector load and facilitating dynamic sectorisation of ATC for enhanced safety and efficiency.

## **1. INTRODUCTION**

1.1 The number of aircraft provided with an air traffic control (ATC) service shall not exceed that which can be safely handled by the ATC unit concerned under the prevailing circumstances. In order to define the maximum number of flights which can be safely accommodated, it is required to assess and declare the ATC sector capacity for control areas, for control sectors within a control area. The sector capacity depends on many factors including:

- a) the level and type of air traffic services (ATS) provided;
- b) the structural complexity of the control area, the control sector concerned;
- c) controller workload, including control and coordination tasks to be performed;

- d) the types of communications, navigation and surveillance systems in use, their degree of technical reliability and availability as well as the availability of backup systems and/or procedures;
- e) availability of ATC systems providing controller support and alert functions; and
- f) any other factor or element deemed relevant to controller workload.

1.2 It is also important that where traffic demand varies significantly on a daily or periodic basis, facilities and procedures should be implemented to vary the number of operational sectors or working positions to meet the prevailing and anticipated demand on a dynamic basis.

1.3 With a view to meeting the above requirement, controller workload needs to be monitored on a dynamic basis to provide information to the decision makers for optimizing manpower and resources. The controller workload is the time spent to process all tasks for individual controller positions in a given period of time. This workload estimation requires huge amount of data to be processed in a relatively short duration of time.

## 2. DISCUSSIONS

2.1 The ATC sector capacity to handle flights is determined primarily by the controller workload. When the air traffic in a sector exceeds the capacity of the controller then safety is likely to be compromised. Hence sector capacity needs to be determined and notified.

2.2 There are multiple approaches available presently to determine the controller workload right from simple approaches based on load counts per hour in the sector using complex analytical models. The immediate need is to determine the controller workload using a scientific approach that is reliable, repeatable, incorporating the numerous factors affecting the measurement of workload and that helps in dynamic management of the air space.

2.3 In the absence of any standardized approach to determine/predict/model the controller workload for a defined sector, Chennai ATM is developing a proposal as mentioned below:

2.4 As recommended in the Fifth Meeting of Air Traffic Flow Management Steering Group (ATFM/5G4/4-IP/04), the ATC tasks are categorized into four major tasks background, transition tasks, recurring tasks and conflict tasks. These tasks are broken down into numerous activities carried out by the controller.

2.5 The fast time simulation is employed to process huge historic data to estimate and fine tune the timing calculated empirically for each major ATC task in a sector. This vastly improved timing for each ATC task will be used as an input for an analytic approach to determine controller workload for the sector and the sector capacity (declared as threshold values).

2.6 Post assessment of the threshold values for controller workload and sector capacity, there is a need to continuously monitor and predict controller workloads for airspace sector management both in short and long terms. This requires processing of large number of interacting factors. As their interactions are not quantifiable, it is preferable, if the same can be learnt from data to estimate the sector capacity and controller workload. As neural network (a computer system modelled on the human brain and nervous system) models have the capability to ingest and process multiple complex inputs to learn, determine and predict, the same is proposed to be used for estimating controller workload.

2.7 The computed threshold sector capacity and calculated controller workload for the sectors will be used as an input to a Neural along with live traffic feed to learn the relationship between input traffic and controller workload for a defined sector.

2.8 Once the network is trained to learn controller workload estimation based on input traffic and other complex inputs, the values obtained through Neural can be used for comparison with the threshold values. In addition to using this method for real time assessment of airspace sector management requirement based on live traffic data feeds and flight plans, it can be also used for long term airspace sector management plan based on flight schedules and flight plans.

2.9 This machine learning method for forecasting controller workload will enable an ANSP to handle huge amount of operational data and other complex inputs to provide faster and more reliable results compared to conventional methodologies.

2.10 The approach based on Neural Networking will provide a quick methodology to compute controller workload paving way for forecasting long term airspace sector management plan and dynamic sectorisation leading to enhanced safety and efficiency of aircraft operations

### **3. ACTION BY THE MEETING**

3.1 The meeting is invited to:

- a) note the information contained in the paper; and
- b) request ICAO to impress upon States to share their best practices on the subject and take up on priority the need for standardising the methodology for dynamic ATC sector load determination for uniform implementation.

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