**International Civil Aviation Organization**
**South American Regional Office**

**SECOND WORKSHOP/MEETING OF THE SAM IMPLEMENTATION GROUP (SAM/IG/2)**
**REGIONAL PROJECT RLA/06/901**

**Lima, Peru, 3 to 7 November 2008**

**Agenda**
**Item 4:** **Implementation of the air traffic flow management (ATFM) in the SAM Region**

# METHODOLOGY ADOPTED BY BRAZIL TO CALCULATE THE CONTROL CAPACITY OF APP AND ACC

(Presented by CGNA- Brazilian Air Navigation Management Center)

**Summary**

This working paper has the objective of introducing to ICAO the methodology adopted by Brazil to calculate the sector control capacity of APP and ACC.

**Reference:**

- ICA 100-30- ATC personnel planning and work timetable, Airspace Control Department (DECEA). Rio de Janeiro, 2007

## 1 Background

1.1 DECEA adopts a methodology to determine the capacity of APP and ACC sectors which makes possible to obtain a reference value for the sector's capacity. It consists in obtaining a value, calculated through a mathematical formula, whose basic data are extracted from a research carried out by a group at the ATC unity, considering a moment of heavy activity, when the controller's actions and his availability, at that moment, to control the traffic of the control sector are observed and timed. When an estimated capacity is being successfully applied to the sector at issue, that phase is not necessary.

## 2 Discussion

2.1 CAPACITY INVESTIGATION THROUGH MATHMATICAL FORMULA

The term ATC capacity reflects the capacity of the ATC system or of any of its subsystems, or operational positions, to provide the aircraft the services foreseen within the regular activities of these unities.

In Brazil, the capacity of ACCs is calculated by observing the capacity of their sectors which are analytically obtained, according to the methodology established in the ICA 100-30, ATC personnel planning (DECEA, 2007). In this way, the model used in Brazil can be classified as mesoscopic (where some additional detail is taking into consideration) and analytical (through mathematical formulas).

Nowadays, the calculated value can be understood as the maximum number of aircraft that can be simultaneously controlled by each operational position (ATCO), so providing the capacity carried out by the ATC unity. It is worthy to emphasize that DECEA has been working on new concepts which, in the future, will consider that value as a reference to be adjusted according to operational judgment.

According to the current model, the controller’s work load is the summation of the time spent on each of the following tasks:

1. communications (transmission/reception);
2. manual activities (filling out strips) and coordination; and
3. traffic planning and distribution.

The Brazilian methodology applies the concept of the controller’s **“availability factor”** ($\phi$), which is defined as the percentage of time available for the ATCO to plan the aircraft separation procedures.

This availability factor is found, usually, between a minimum value of 40% of the ATCO time, for no radar control, and 60% for radar (ICA 100-30). Efforts shall be focused on increasing $\phi$ and the only way to achieve this goal is by applying measures which reduce the controller’s engagement with the activities mentioned in 1 and 2.

This factor $\phi$ can present a bigger percentage when the Man / Machine Interface – MMI is enhanced.

In Brazil, the number of aircraft that can be simultaneously controlled by a controller (N), within the sector at issue, is calculated through the following formula (ICA 100-30):

$$\mathbf{N = \phi \cdot \delta \cdot (\eta \cdot \tau_m \cdot \nu_m)^{-1}} \qquad \mathbf{(1)}$$

In the formula (1), the ATC capacity is inverse or direct function of some factors (ICA 100-30), as follows:

- **Factores directly proportional to the ATC capacity:**

$\phi$ : factor of controller availability, defined as the percentage of time available to plan the aircraft separation procedures;

$\delta$ : average distance flown by aircraft in the sector, which is function of the pathways and route or terminal established for each sector;

- **Factors inversally proportional to the ATC capacity:**

$\eta$ : number of communication for each aircraft in the sector, which must be restricted to the necessary minimum for the understanding between pilot and controller. That number can be minimized by issuing a full clearance with the necessary anticipation to allow the flight planning;

$\tau_m$ : average length of time of each message. This factor can be minimized by transmitting messages in an objective way, avoiding long explanations which are detrimental as far as the understanding between pilot and controller is concerned; and

$\nu_m$ : average speed of the aircraft in the sector.

Replacing $\delta$ y $\nu_m$ by the average flight time spend by the aircraft crossing the sector (T), that formula can be replaced by a simpler version:

$$\mathbf{N = \phi \cdot T \cdot (\eta \cdot \tau_m)^{-1}} \qquad \mathbf{(2)}$$

The values of the factors $\phi$, T, $\eta$ and $\tau_m$ are collected empirically, following the standardized procedures.

As an example, we can consider T= 12 minutes, $\tau_m$ = 9 seconds, $\phi$ = 60%, $\eta$= 6, which results in a number of simultaneous aircraft N = 8 per controller in the referred sector. In other words, in this sector and under these conditions, a controller would control 8 aircraft simultaneously.

Several factors are constantly influencing number N. Factors directly related, for instance, sector size or route modification. Thus, every time a significant change is notice, it is necessary an update of the determined value. Besides, it is important that the data gathering be very expressive, in order to dilute the provisional stochastic deviations and to represent trustworthy values to the ATC unity.

In ideal conditions, data research shall be conducted when there is a heavy air traffic activity, for this reason to choose the ideal season is a factor to be considered, once it has a direct influence in final results.

## 3 Action suggested

3.1 The meeting is invited to:

a) Analyze the information presented in the Working Paper.

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