International Civil Aviation Organization

Fifteenth Meeting of the Asia/Pacific Air Traffic Flow Management Steering Group (ATFM/SG/15)

Bangkok, Thailand, 28 April – 02 May 2025

Agenda Item 4: Review of Current ATFM Operations and Problem Areas

BENEFIT OF MEASURING REDUCED AIR DELAYS, FUEL SAVINGS AND REDUCTION IN CO2 EMISSIONS DUE TO IMPLEMENTATION OF AIR TRAFFIC FLOW MANAGEMENT (ATFM) AND SHARING IT WITH STAKEHOLDERS IN ACHIEVING OPERATIONAL EFFICIENCY; CALCULATIONS THEREOF.

(Presented by India/Airports Authority of India)

SUMMARY

Airports Authority of India (AAI) is undertaking computation of reduced air delays, fuel savings and reduction in CO2 emissions due to implementation of flow measures as a part of ATFM post operational report to demonstrate stakeholders that an ATFM service can provide significant business and operational benefits to the air traffic network. Measuring the performance of an ATFM system through reduced air delays, fuel savings and reduction in CO2 emissions, enables users to identify, ATFM contribution to the overall ATM operational environment

Flow measures implemented through collaborative decision-making process lead to a predictable environment providing enhanced common situational awareness to stakeholders resulting reduced air delays, fuel savings, reduction in CO2 emissions and operationally efficient ATM system.

1. INTRODUCTION

1.1 Airports Authority of India (AAI) has established a Central Air Traffic Flow Management (C-ATFM) unit in India. The C-ATFM network consist of a Central Command Center (CCC) at Delhi supported by Flow Management Positions (FMPs) at major Area Control Centres (ACCs) and ATC towers across the country. Air Traffic Flow Management (ATFM) is a service established in order to contribute to a safe, orderly and expeditious air traffic movement, ensuring that air traffic volume is compatible with capacities declared by the ATS authority. ATFM is primarily meant to address the balancing of demand against the capacity to achieve optimum utilization of the major resources viz., Airport, Airspace and aircraft at every Indian airport where there is a capacity constraint. The CCC provides Air Traffic Flow Management (ATFM) service in conjunction with the FMPs.

1.2 The benefits of air traffic flow management have been mentioned in the ICAO DOC 9971, Manual on collaborative air traffic flow management. However, sometimes, some stakeholders share their concerns about the objectives and benefits of Air traffic flow management in attaining operational efficiency. In order to mitigate such concerns, AAI-ATFM unit has started calculating the benefits such as reduced air delays, fuel savings and reduction in CO_2 emissions accruing due to the implementation of Flow measures. AAI is sharing such information with stakeholders through its monthly and annual post ops reports and associated review meeting. Such reports are also available on AAI portal

https://www.atfmaai.aero/portal/en/news on the tab News.

1.3 In India, ATFM played a greater role during year 2024 and implemented ATFM measures on 757 occasions to balance demand capacity imbalance at airports across the country. This resulted in fuel savings of 32653.7 tons amounting to the reduction in CO_2 emissions of approximately 103185.83 tons.

2. DISCUSSION

2.1 Doc 9971 has emphasized the need of developing a methodology to balance demand and capacity for minimizing the effects of ATM system constraints. This can be accomplished through the application of an "ATFM planning and management" process, wherein airport operators, ANSPs, AUs, military authorities, and other stakeholders work together to improve the performance of the ATM system.

2.2 The final step in the ATFM planning and management process is the post-operations analysis phase. The analytical process is aimed at measuring, investigating and reporting on operational processes and activities identifying best practices and lessons learnt meant for further improving the ATFM operations

2.3 Since the commencement of ATFM operations in India in 2017, various performance indicators aligned with DOC9971 and Asia Pacific post operations analysis recommended framework such as 'Demand Analysis', 'ATFM Measure Metrics and Analysis' and 'Case studies' are captured, reviewed and shared regularly with all concerned stakeholders.

2.4 Post operations analysis is conducted after application of ATFM measures considering the original scenario, evaluating planned outcome versus actual ATFM operations, Flight data accuracy, Airlines, Airport & ATC participation, reason for non-compliance, reduction in Air delay due to application of ATFM measures leading to Fuel saving and reduction in CO_2 emissions etc.

2.5 **Calculation of reduction in Air delay due to application of ATFM measures**: It is calculated as difference of total air delay (with no ATFM measures) and total air delay (with ATFM measures) i.e.

Total reduced air delay = Total Air Delay (with no ATFM measures) - Total Air Delay (with ATFM measures)

Assumptions:

2.5.1 When ATFM measures are not in force, all flights take off at their Estimated take off time (ETOT) where Estimated take off time (ETOT)= Estimated off block time (EOBT) + default taxi time

All flights have an Estimated elapsed time (EET) as calculated by ATFM automation system (SKYFLOW) using the Flight Plan information and Basic Aircraft data.

Methodology:

Air delay (with no ATFM measures) is calculated as the sum of Air delay for all the flights (during the Flow measured period) with no ATFM measures in place where the air delay for each flight is the difference in its ideal landing time and its ideal estimated landing time.

Total Air Delay (with no ATFM measures) = $\sum$ (Ideal LDT - Ideal ELDT)

Ideal LDT is taken by assuming every flight is landing at a specified interval based on the Arrival acceptance rate (AAR) defined.

Ideal LDT = ETOT + SKYFLOW calculated Flying time + Inter Arrival spacing considering AAR

Ideal ELDT = ETOT + SKYFLOW calculated Flying time

2.5.2 Total Air delay (with ATFM measures in force) is calculated during the period when ATFM measures are in force by summing the air delay for all the flights landing at constrained Airport.

Air delay (with ATFM measures) is defined as difference between actual elapsed time (AET) & estimated elapsed time (EET)

where actual elapsed time (AET) can be obtained from Actual landing time (ALDT) – Actual take-off time (ATOT)

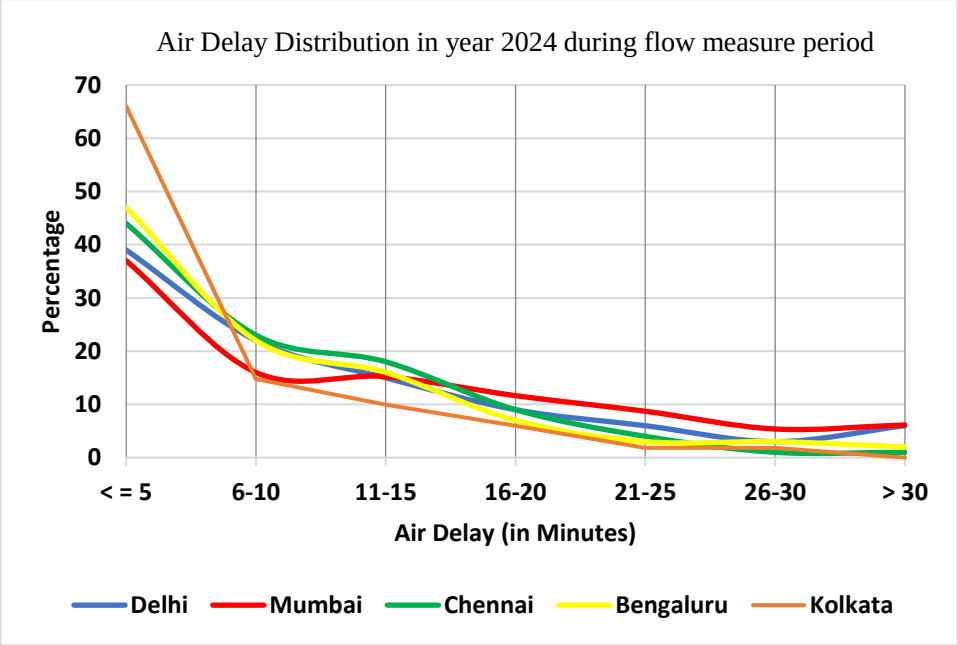
Estimated elapsed time (EET) as calculated by ATFM automation system (SKYFLOW) using the Flight Plan information and Basic Aircraft data or Flight plan (FPL/RPL)

Thus, Air delay = actual elapsed time (AET) - estimated elapsed time (EET) for an aircraft

Total Air Delay (with ATFM measures) = ∑ (Actual elapsed time – SKYFLOW calculated EET)

2.5.3 Air Delay during the flow measure period in year 2024:

In the year 2024, the Average Air Delay to domestic arrivals during the period when ATFM measures were in force for Delhi, Mumbai, Chennai, Bengaluru and Kolkata are 10.5 min, 11.8 min, 8.1 min,7.9 mins and 5.1 mins respectively.



Inference:

2.5.3.1 76% of arriving flights to Delhi had an Air delay equal to or less than 15 minutes during the CDM period.

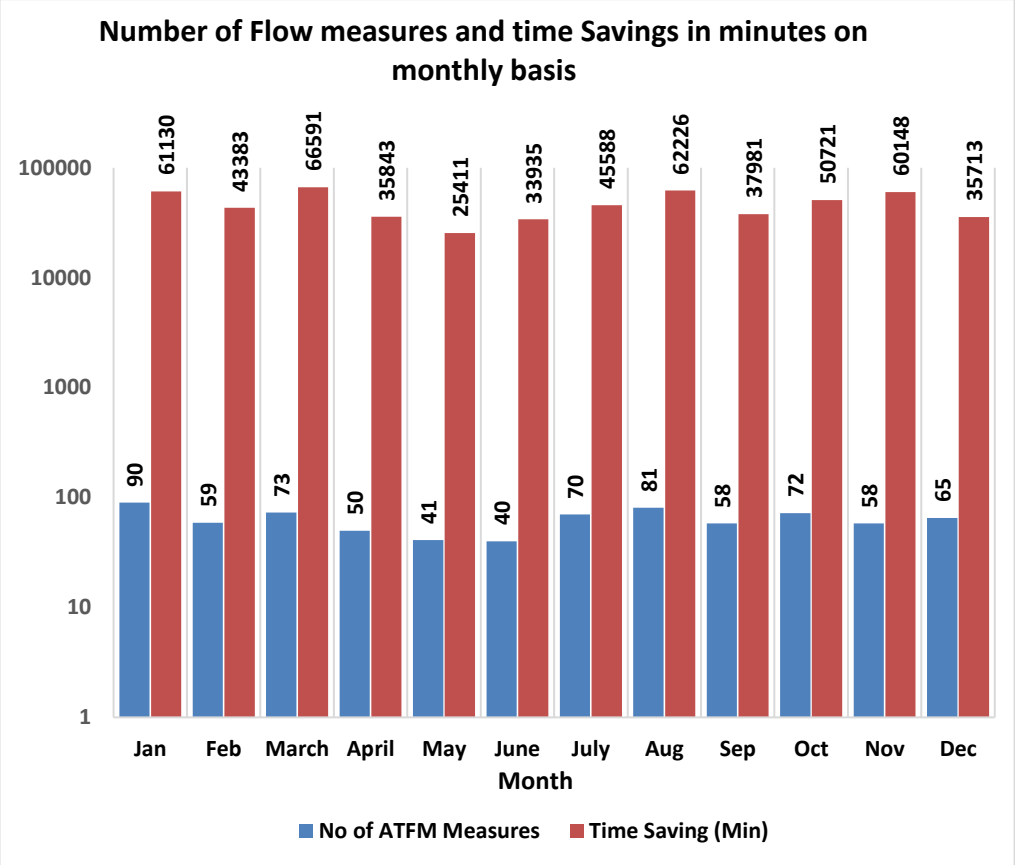
2.5.3.2 68% of arriving flights to Mumbai had an Air delay equal to or less than 15 minutes during the CDM period.

2.5.3.3 85% of arriving flights to Chennai had an Air delay equal to or less than 15 minutes during the CDM period.

2.5.3.4 85% of arriving flights to Bengaluru had an Air delay equal to or less than 15 minutes during the CDM period.

2.5.3.5 91% of arriving flights to Kolkata had an Air delay equal to or less than 15 minutes during the CDM period.

2.5.3.6 **Details of the number of flow measures applied and reduced air delay [time saved] on monthly basis due to application of flow measures are shown below**:



Total number of flow measures applied in year 2024 = 757
Total Air Delay (with ATFM Measures) in year 2024 = 505471 mins
Total Air Delay (with no ATFM measures) in year 2024 = 1064141.14 mins
Reduction in Air delay due to ATFM measures in year 2024 =
1064141- 505471= 558670 Min~9311 Hrs

2.6 **Calculation of fuel saving due to application of ATFM measures**;

Great Circle Distance (GCD) is calculated for all the arrivals during the ATFM Measure from the point of origin to destination.

Assumption

2.6.1 Airbus 320 has been considered as reference aircraft for flights (flight distance equal to or less than 3000 nm) and B777 for flights (flight distance more than 3000nm)

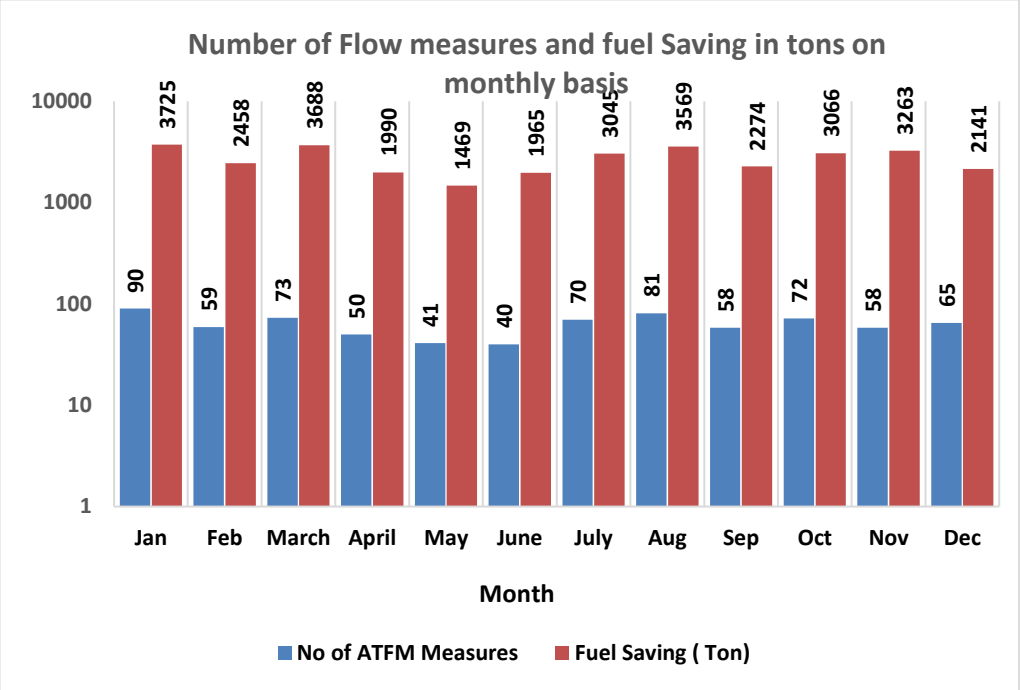
2.6.2 Fuel consumption (Kgs) for each affected flight in the scenario was then calculated using the reference document: ICAO Carbon emissions calculator methodology, version10, Appendix C: ICAO Fuel Consumption Table.

2.6.3 The Fuel consumed per minute (Kg/min) was calculated for each affected flight considering the time taken.

2.6.4 The reduction in air delay calculated for each affected flight as per para 2.5, is multiplied to the Fuel consumed per minute (Kg/min), so as to arrive on the data of fuel saving for each affected flight. Total fuel saved during a flow measure is sum of the fuel savings calculated for all the arriving flights operated during the flow measures. At the end of every

month and year such data is collated and presented in the monthly and annual Post operations report.

2.6.5 **Details of the number of flow measures applied and fuel savings on monthly basis due to application of flow measures are shown below**:

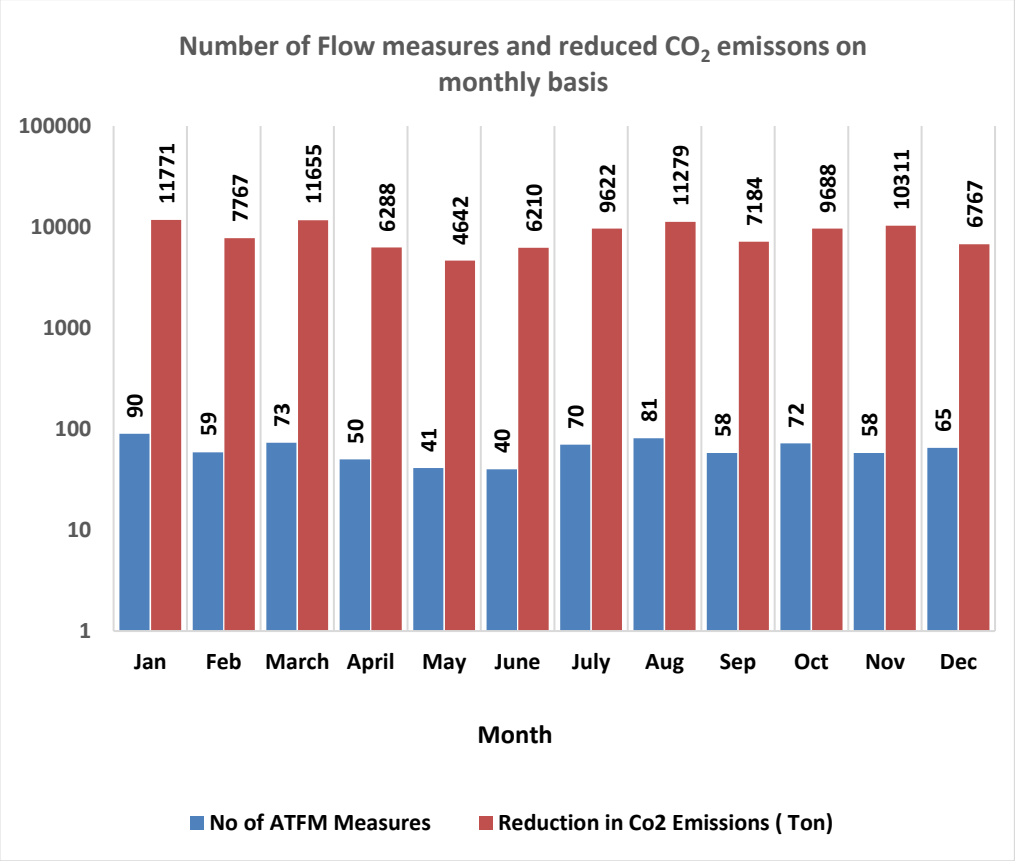


Total Fuel saved during the ATFM Measure: 3,26,53,743.4 Kg ~ 32654 Tons

2.7 **Calculation of CO_2 savings due to application of ATFM measures**:

Based on the ICAO Carbon Emissions Calculator Methodology, the fuel savings (in kg) is then converted to reduced CO_2 emissions (in kg) by multiplying it by a factor of 3.16 for each affected flight. Total reduction in CO_2 emissions during a flow measure is sum of the reduction in CO_2 emissions calculated for all the arriving flights operated during the flow measures. At the end of every month and year such data is collated and presented in the monthly and annual Post operations report.

Details of the number of flow measures applied and reduced CO_2 emissions on monthly basis due to application of flow measures are shown below:



Total reduction in CO_2 emissions: 3.16($KgCO_2$/kg fuel) * 3, 26, 53, 743.4 Kg
= 10, 31, 85, 829.1 Kg ~ 103186 Tons

2.8 AAI-ATFM team capture the data from ATFM automation system (SKYFLOW) from its various modules and use such data in the specially designed excel macro to calculate reduction in air delay, fuel savings and reduction in CO_2 emissions due to application of ATFM measures for each and every flow measure. At the end of every month and year such data is collated and presented as a part of monthly, annual Post operations reports and review meetings. Such report is shared with stakeholders and also uploaded in the AAI ATFM portal.

2.9 It is important that in review meetings, stakeholders should be encouraged to recognise the overall benefits of implementation of Flow measures to achieve operational efficiency in terms of average reduction in air delay, increase in fuel savings, and reduction in CO_2 emissions. Such exercise keeps stakeholders motivated and committed to participate in collaborative decision-making process of air traffic flow management leading to enhanced operational efficiency of ATM operations.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) Note the information contained in this paper; and

b) Discuss any relevant matters as appropriate.

— END —