POST OPERATIONS ANALYSIS REPORT

October, 2024

CENTRAL COMMAND CENTER, C-ATFM, DELHI

Contents

List of Figures

A. Executive Summary

Average Domestic air traffic has recorded an increase of 2.43% whereas the average international air traffic has decreased by 0.07 % in the month of October '24 as compared to September '24.

On average, the Indian Airports in the ATFCM area saw 4633 IFR flights per day in the month of October 2024. The peak day was on 23rd October 2024 (4790 IFR flights). Wednesday's were the busiest days throughout this month with an average of 4632 IFR flights per day.

Total Seventy two (72) ATFM measures were applied this month during periods of congestion at Bengaluru, Chennai, Delhi, Kolkata and Mumbai Airport.
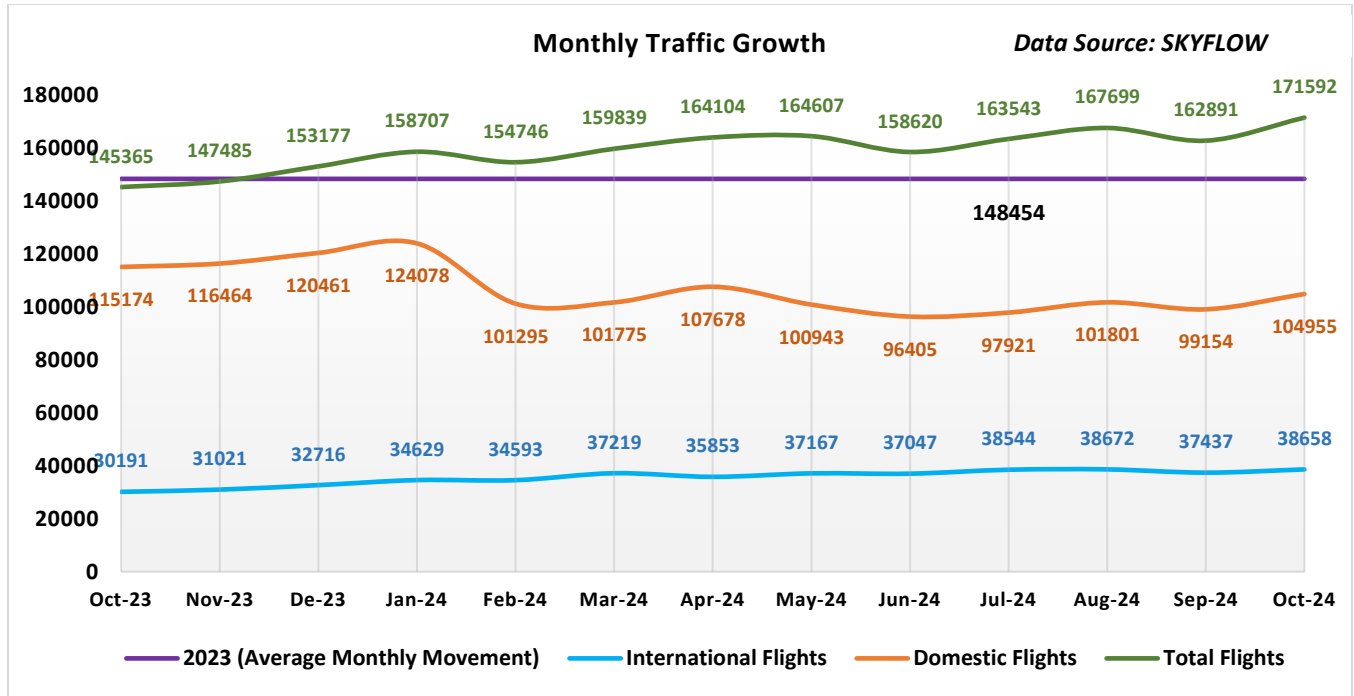
Figure 1: Monthly Traffic Growth

The graph above depicts the Domestic, International and Overflying Air traffic in Indian ATFCM Area during the last 13 months (October'23 to October'24).

B. Traffic Analysis

I. Air Traffic Movement at Major Airports in India
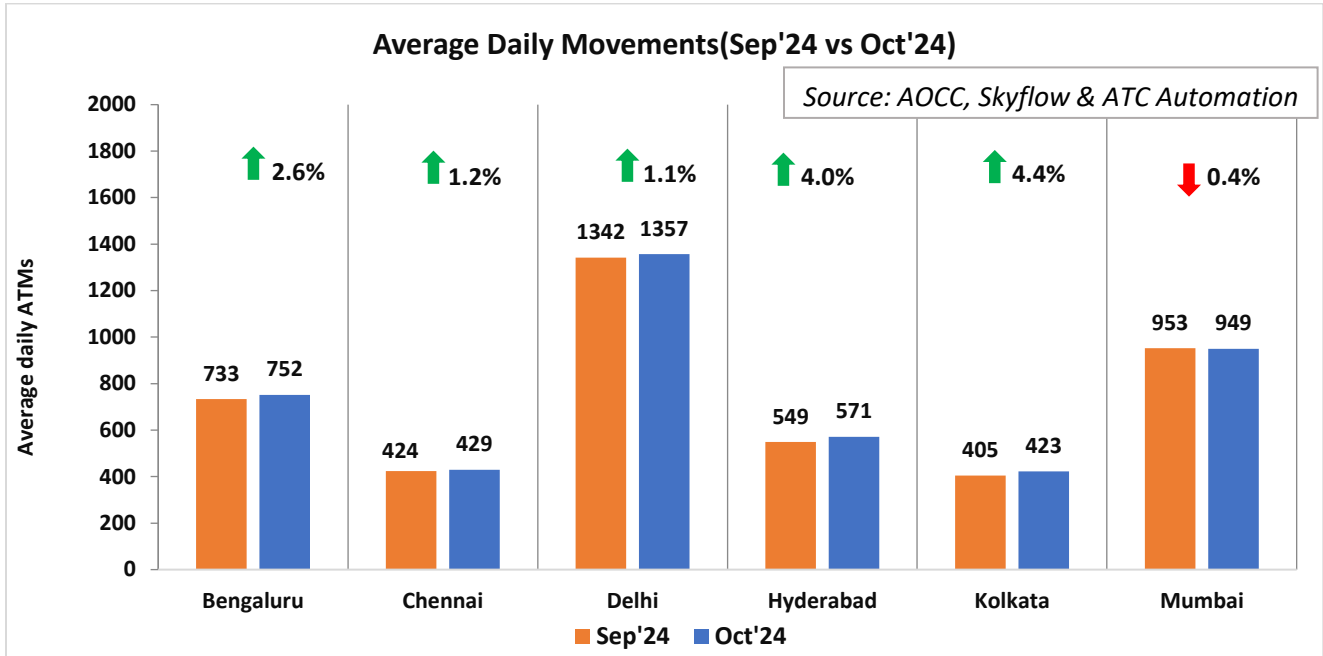
Figure 2: Average Daily Movements (Sep '24 vs Oct '24)

The above chart depicts the percentage change in average daily ATMs at six major Airports in October'24 as compared to the previous month September '24.

Airports\Year	Avg. Daily ATMs (YoY) for six major airports				
	Oct'20	Oct'21	Oct'22	Oct'23	Oct'24
Bengaluru	318	486	620	666	752
Chennai	205	281	356	404	429
Delhi	734	1074	1224	1284	1357
Hyderabad	266	372	436	479	571
Kolkata	208	328	392	400	423
Mumbai	301	627	801	915	949

Air Traffic Movement for each day in October'24 is plotted for Delhi, Mumbai, Bengaluru and Hyderabad Airport along with the percentage change w.r.t. Avg. Daily Movements for the same month.
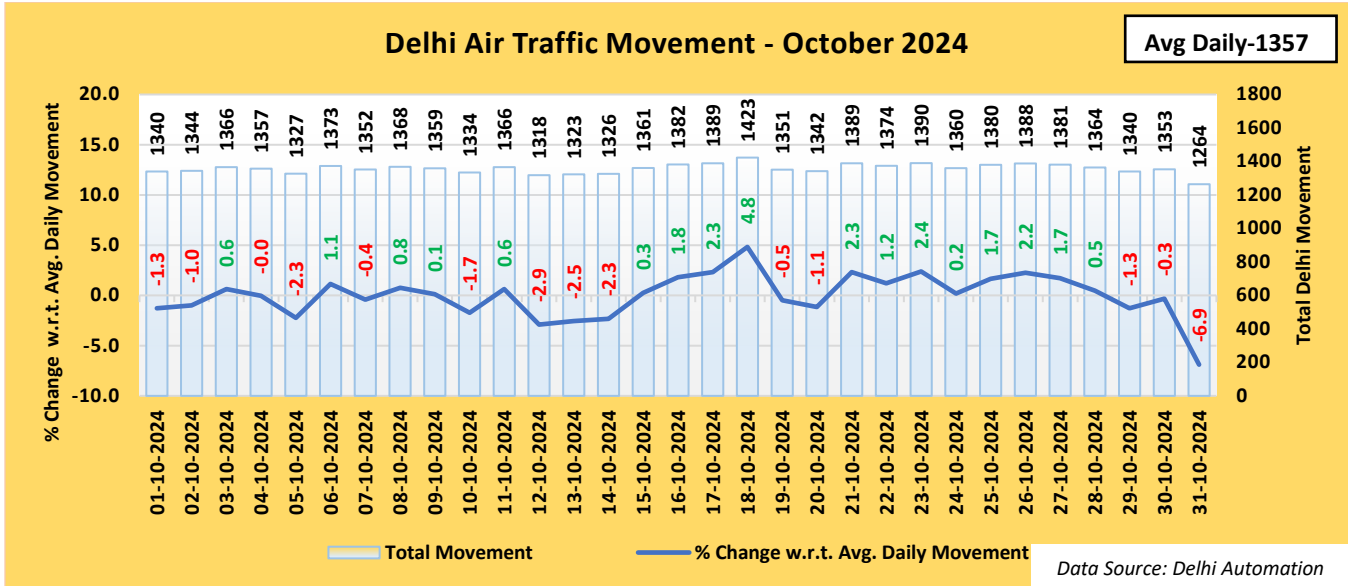
Figure 3: Air Traffic Movement for Delhi –October 2024
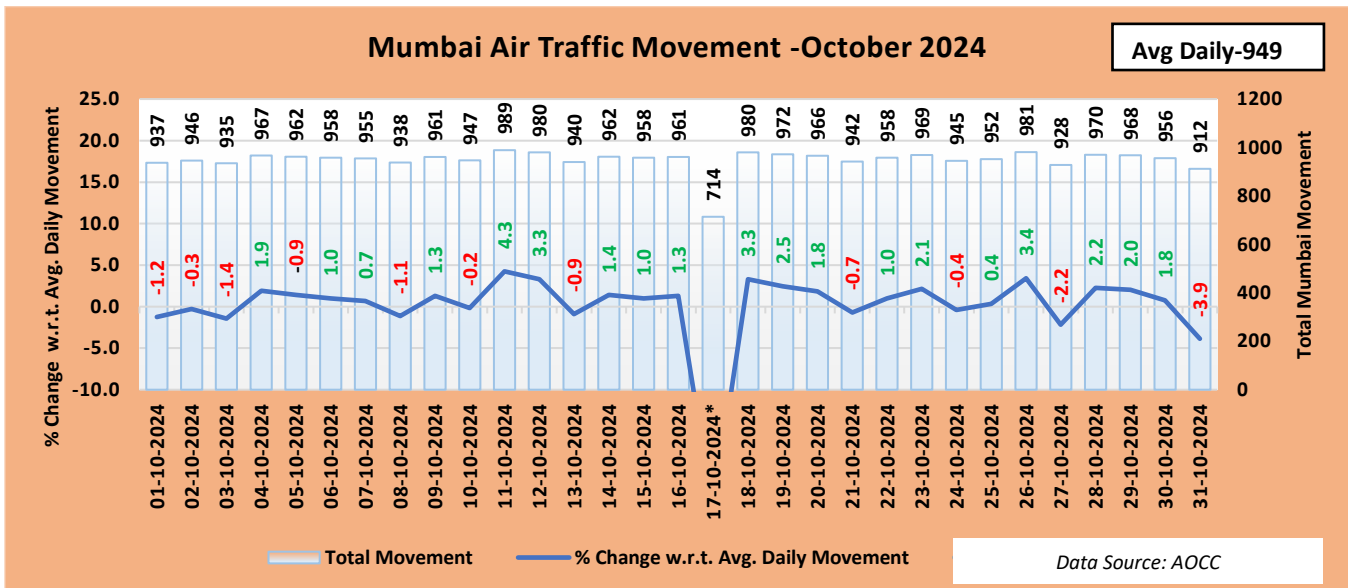
Figure 4: Air Traffic Movement for Mumbai - October 2024

.* Closure at Mumbai Airport for Post monsoon preventive maintenance.
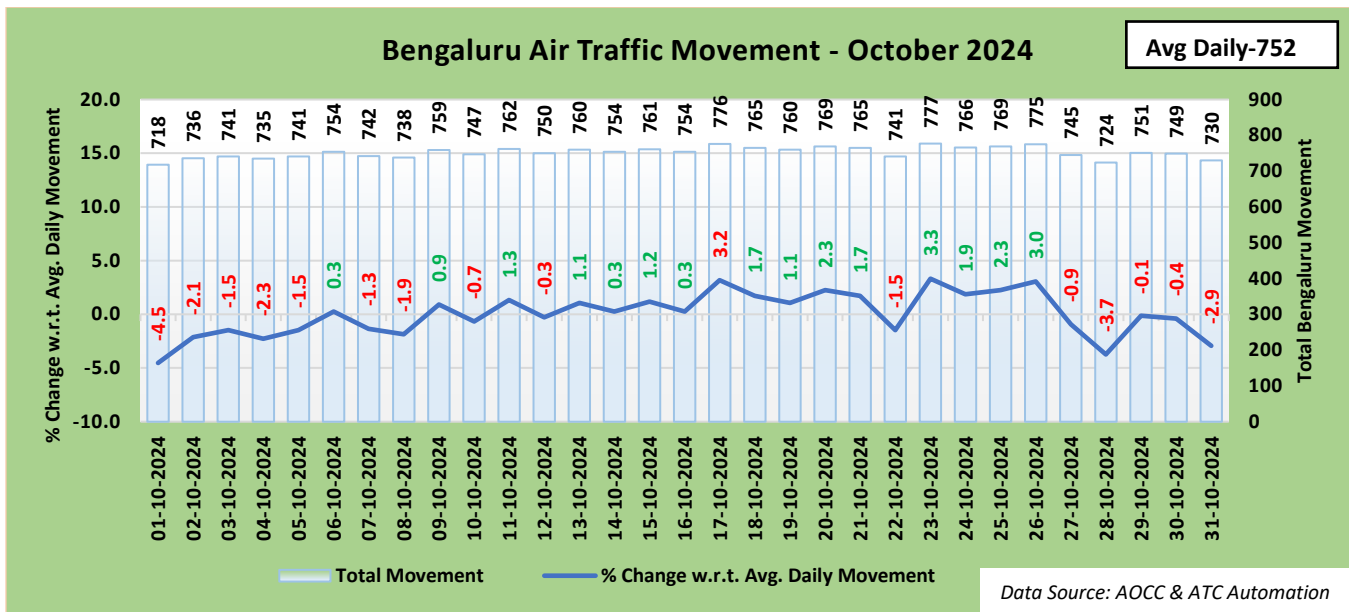
Figure 5: Air Traffic Movement for Bengaluru – October 2024
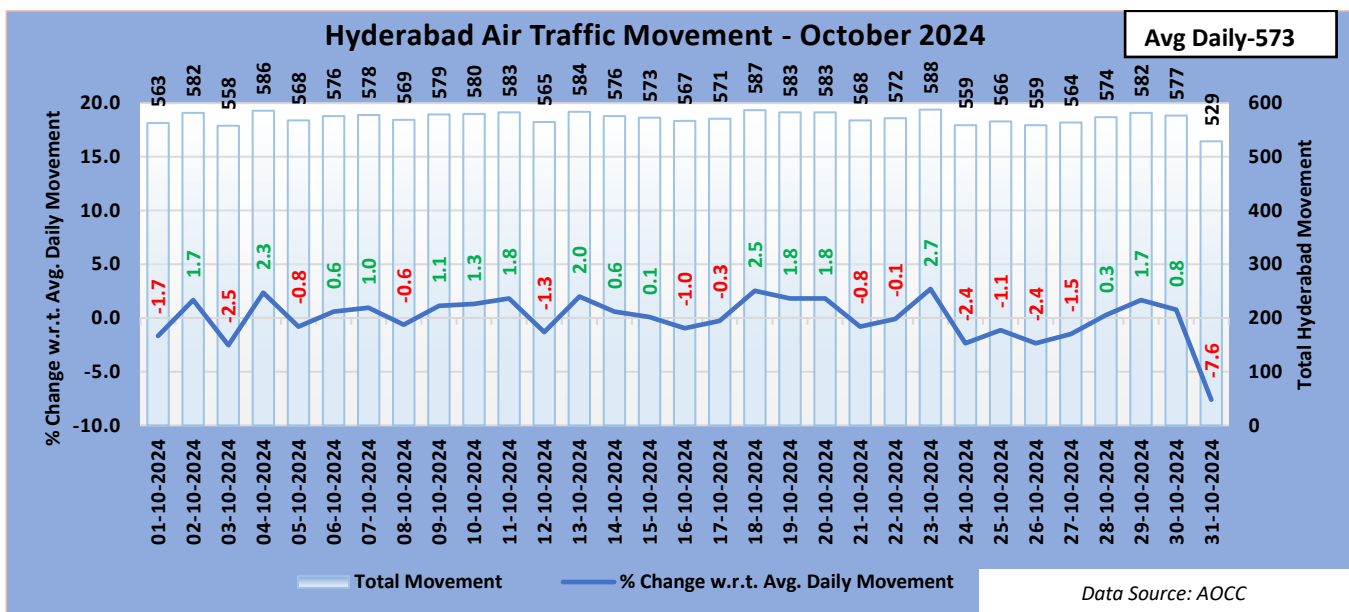
Figure 6: Air Traffic Movement for Hyderabad – October 2024

It can be concluded from the above charts that the ATM at Delhi, Mumbai, Bengaluru and Hyderabad exceeds the average daily movement for 17days, 19 days, 15 days and 17 days respectively in the month of October'24.

II.   Comparison of total ATMs (YoY) and Monthwise

The total Air traffic movement(ATMs) including Passenger and other flights such as Cargo flights, International scheduled, International non-scheduled, Domestic scheduled, Domestic non-scheduled, Air taxi & commercial business flights at six major Indian Airports namely Delhi, Mumbai, Bengaluru, Hyderabad, Kolkata and Chennai is plotted for the month of October for two consecutive years 2023 and 2024 respectively. Air Traffic movement is also plotted Airline wise for the last six months for the major Scheduled Operators.
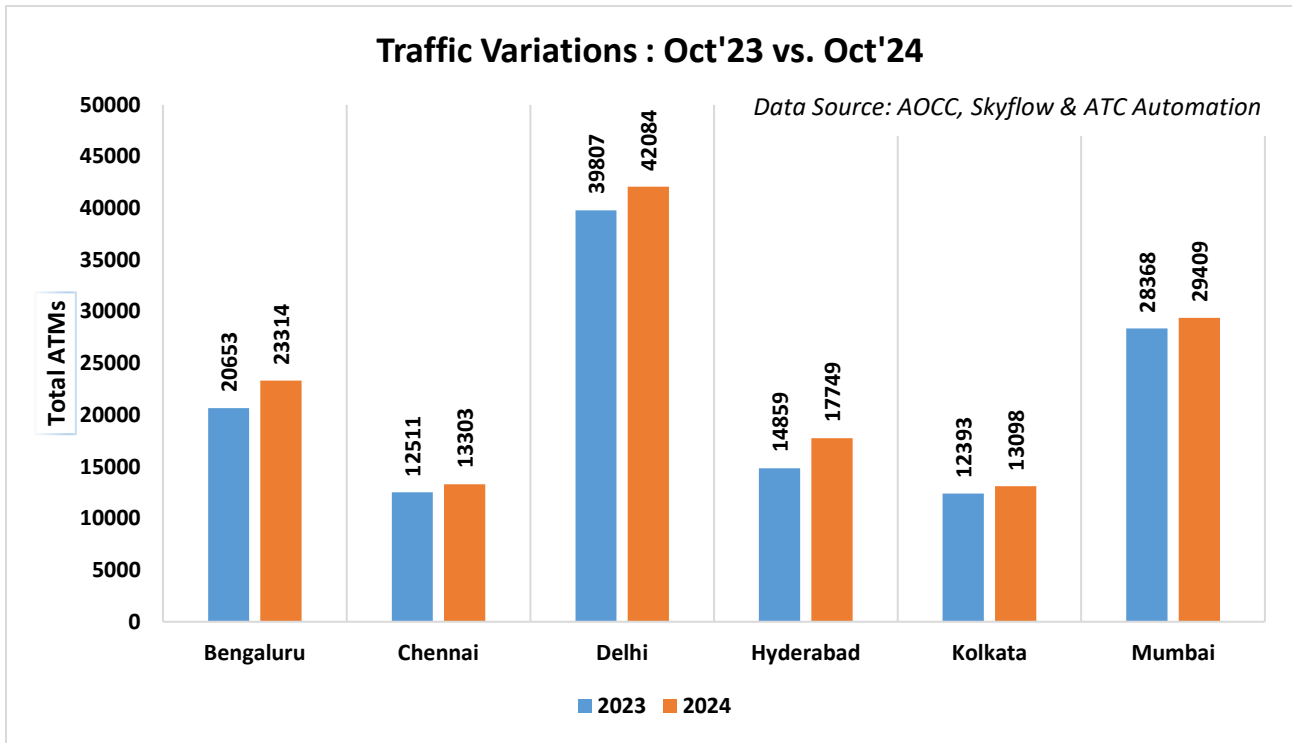
Figure 7: Traffic Variation (YoY)

III.   Flight Operations – Airlinewise
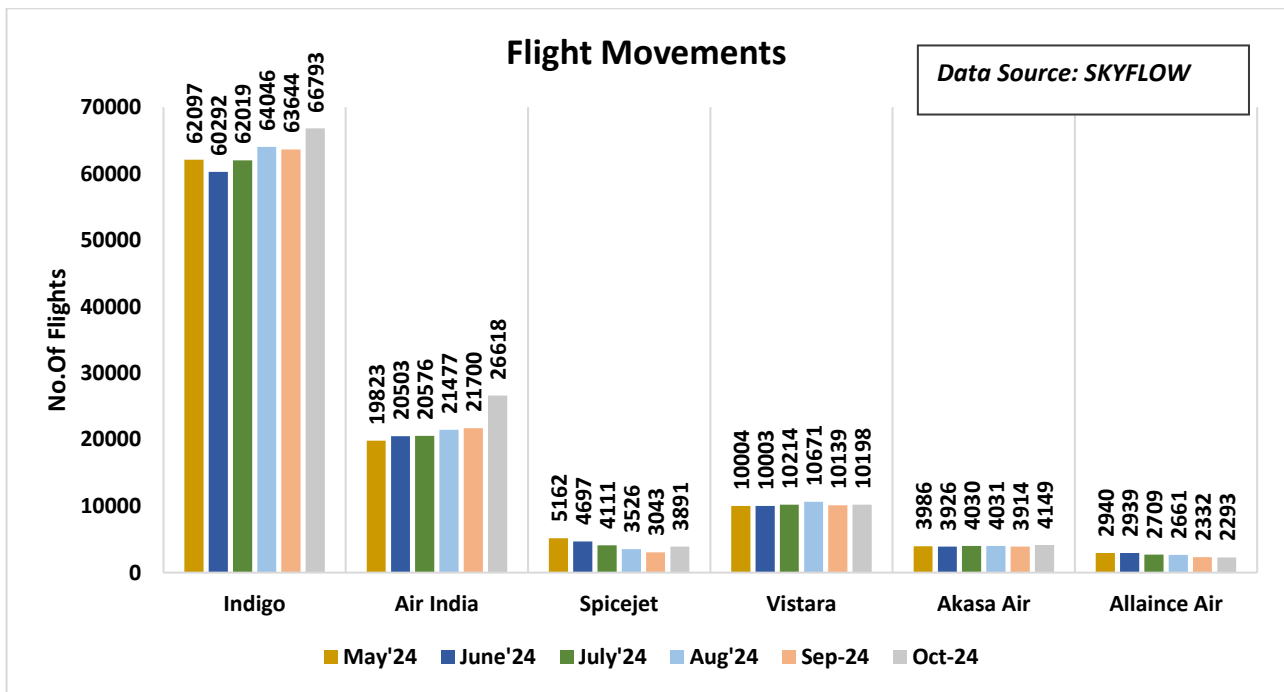
Figure 8: Flight Movements –Airlinewise

Inference:

1. Indigo,Air India,Spicejet and Akasa airlines have recorded an increase in the monthly average(31 days) Flight movement in October'24 as compared to September '24 while Alliance air and Vistara airlines have recorded a decline during the same period.

C.   ATFM Post Operations – CDM Analysis

I.   Introduction

Analysis Period   **1ˢᵗ – 31ˢᵗ October 24**

Back Ground   During the above mentioned period, **Two (02)** ATFM measure was applied **for Bengaluru Airport, Eleven (11)** ATFM measures were applied **for Chennai Airport, Seven (07)** ATFM measures were applied **for Delhi Airport, One (01)** ATFM measures was applied **for Kolkata Airport and Fifty One (51)** ATFM measures were applied **for Mumbai Airport** due to the following reasons as illustrated in the bar chart below:–
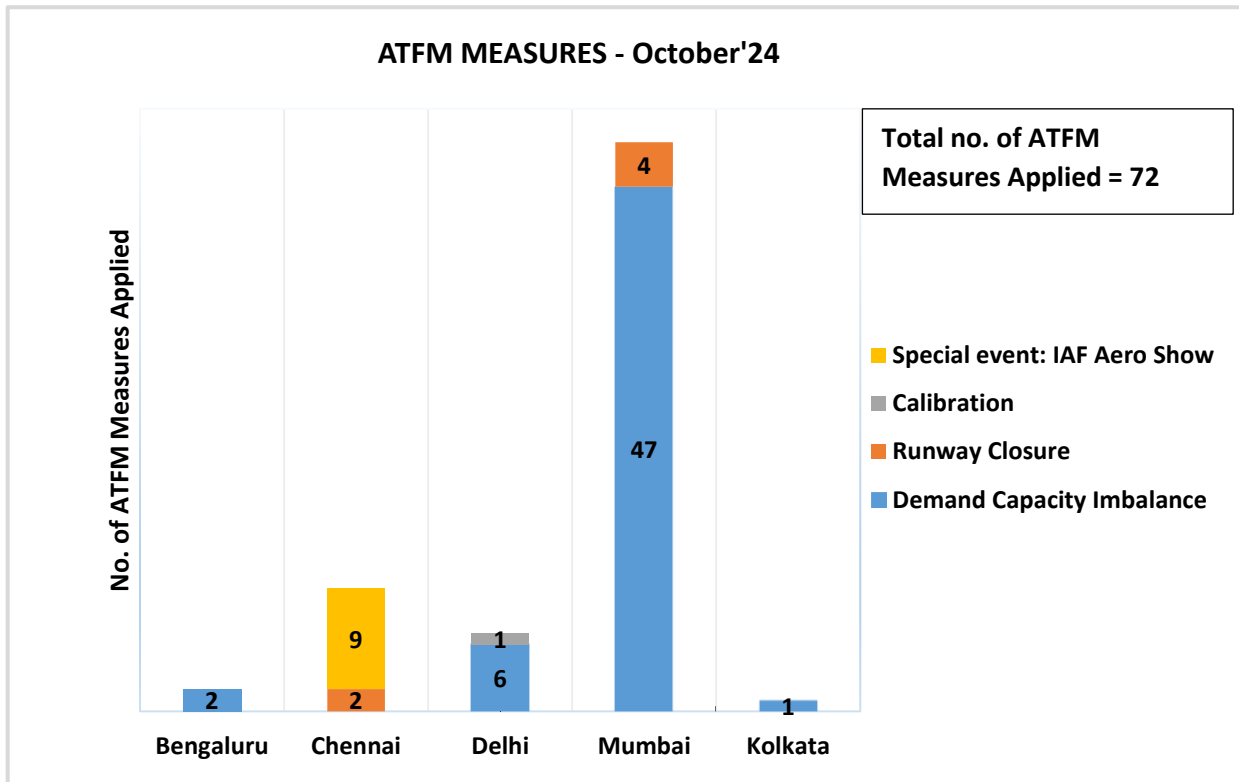
Figure 9: ATFM Measures –Oct'24

II. ATFM Measures Overview

Constrained Airport	Bengaluru	Chennai	Delhi	Kolkata	Mumbai
Number of ATFM measures applied	2	11	7	1	51
Average ATFM Ground delay(in min) due to measures*	20.0	21.5	27.0	20.3	31.7
Maximum ATFM Ground delay(in min) due to measures	45	50	79	41	94
% Compliance	87.2	84.2	73.1	91.9	90.6

Note: * $Average\ ATFM\ Delay = \dfrac{Total\ ATFM\ Delay}{Total\ Domestic\ Arrivals}$

Total Arrivals	5202
Total International Arrivals(exempted)	1258
Total affected flights in scenario (Domestic Arrivals)	3944
Total Domestic Arrivals with zero ATFM delay	344
Total Domestic Arrivals with ATFM delay	3600

Affected Flight Statistics

9%

91%

☐ Delayed flights   ☐ Non-delayed flights
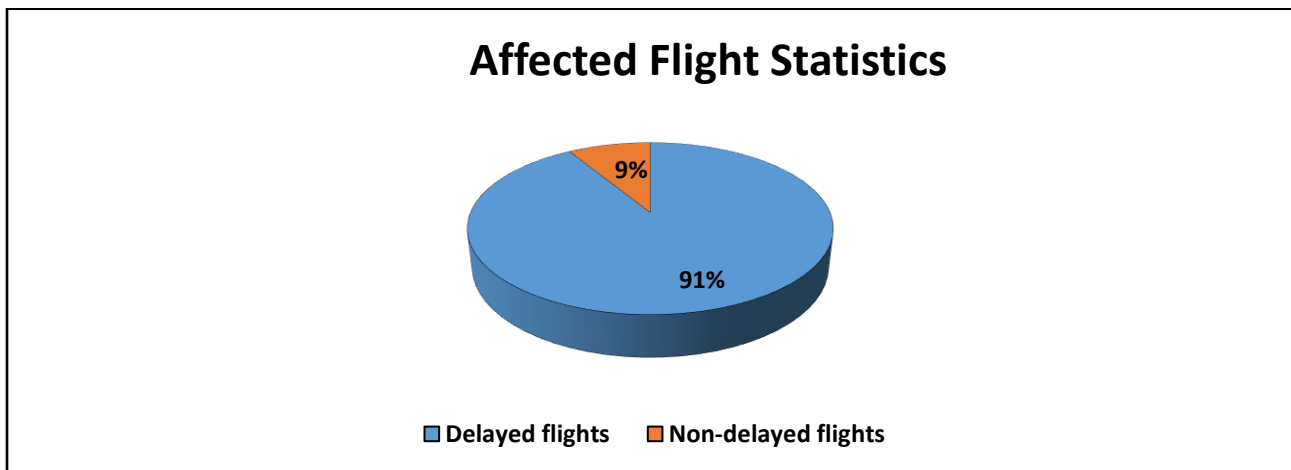
Figure 10: Affected Flight Statistics –Oct'24

III. Overall Compliance

Total arrivals	5202
Domestic arrivals	3944
Flights with complete data (ATOT)	3831
Flights with incomplete data	22
Flights Not Operated	91
Compliant*	3338
Non-Compliant	493

*Total No. of Revised CTOTs issued = 1194 (Compliance calculation for flights which were issued revised CTOT is w.r.t. new CTOT issued)
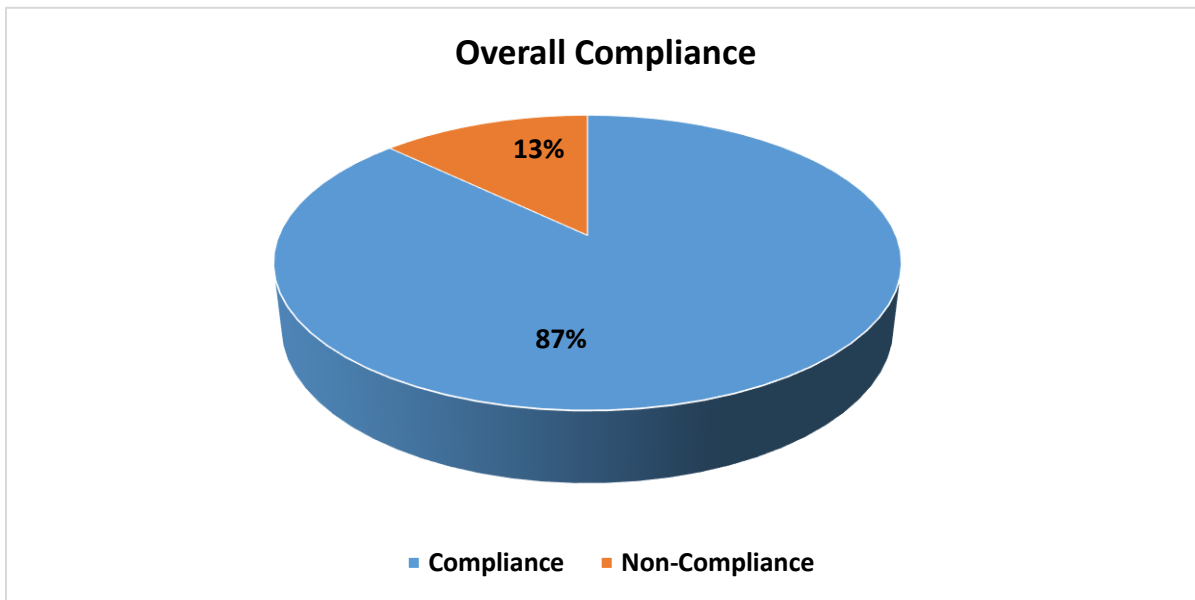
Figure 11: **Overall Compliance – Oct'24**

NOTE: Flights with required data (i.e. ATOT) are only considered for compliance measurement

Out of the total domestic arrivals with complete data in the CDM scenario, 87% arrivals are compliant for the month of October 2024 whereas 86% arrivals were compliant for the month of September 2024 and there has been an increase of 1% in compliance in the month of October'24 with respect to September'24.
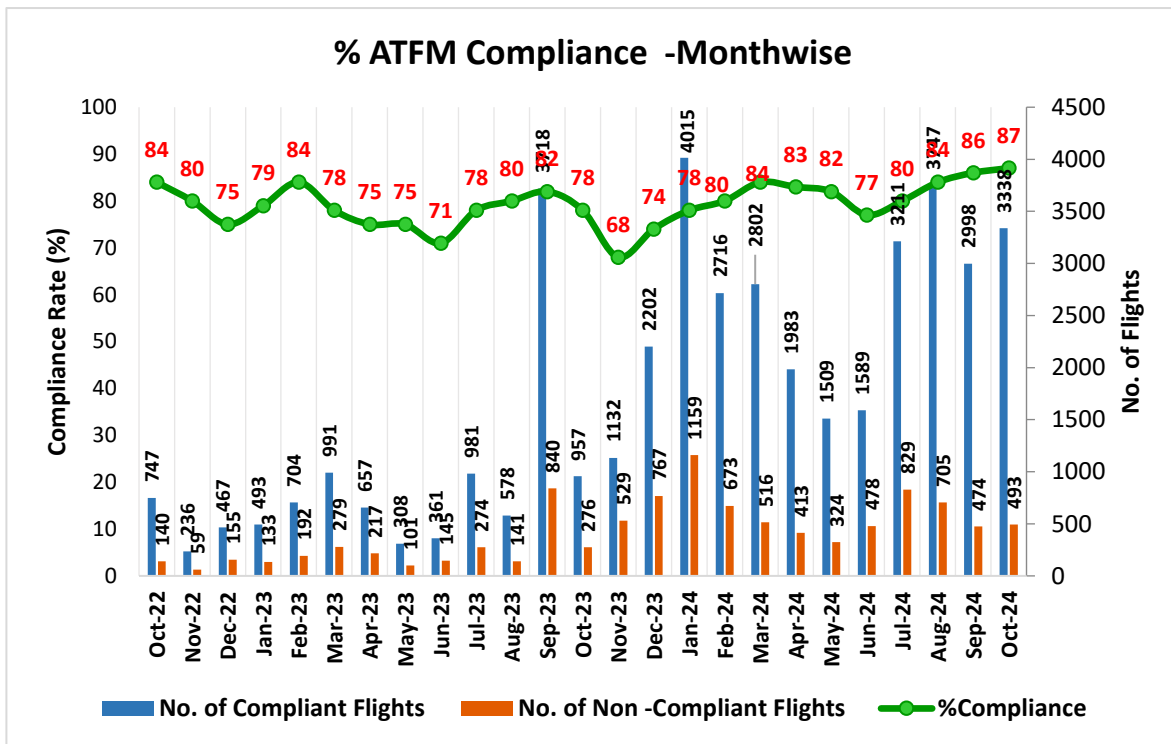
Figure 12: Compliance(Monthwise)

Inference

1. Out of the total arrivals captured(5202 flights) during the CDM scenario for the constrained Airports, 75.8% of flights i.e. domestic arrivals(3944 flights) were candidates for ground delay(participating).
2. Out of these Domestic Arrivals(3944), 91.2% (3600 flights) are assigned ATFM ground delay.
3. Out of the total arrivals captured(5202 flights) to the constrained Airport during the ATFM scenario, 69.2% of flights(3600 flights) were assigned ATFM Ground Delay.

IV. CTOT Compliance rate – Airportwise

MUMBAI FIR (80%)*	Compliant	Non Compliant	% Compliant
Ahmedabad	126	16	89%
Akola	0	1	0%
Aurangabad	31	6	84%
Mumbai	43	33	57%
Vadodara	29	2	94%
Bhopal	36	2	95%
Bhavnagar	1	0	100%
Diu	3	0	100%
Hirasar	21	6	78%
Indore	61	14	81%
Jabalpur	7	1	88%
Jalgaon	5	1	83%
Jamnagar	6	8	43%
Kandla	4	1	80%
Kolhapur	6	1	86%
Keshod	1	0	100%
Mundra	1	0	100%
Nagpur	66	10	87%
Pune	20	11	65%
Ratnagiri	1	0	100%
Shirdi	1	5	17%
Solapur	0	1	0%
Surat	11	2	85%
Udaipur	34	6	85%
KOLKATA FIR (87%)*	Compliant	Non Compliant	% Compliant
Prayagraj	8	5	62%
Agartala	2	2	50%
Ayodhya	31	5	86%
Bagdogra	35	4	90%
Shillong	2	0	100%
Varanasi	59	3	95%
Bhubaneswar	56	4	93%

Bilaspur	1	0	100%
Kolkata	188	22	90%
Chakeri, Kanpur	4	3	57%
Durgapur	5	3	63%
Darbhanga	6	4	60%
Deoghar	3	1	75%
Gorakhpur	19	2	90%
Guwahati	61	9	87%
Gaya	2	0	100%
Hollongi	3	0	100%
Imphal	3	1	75%
Jharsuguda	3	2	60%
Jorhat	0	1	0%
Khajuraho	1	1	50%
Silchar	2	0	100%
Aizawl	4	1	80%
Dibrugarh	1	2	33%
Dimapur	2	0	100%
Patna	54	4	93%
Ranchi	16	9	64%
Raipur	36	3	92%
DELHI FIR (86%)*	**Compliant**	**Non Compliant**	**% Compliant**
Agra	2	1	67%
Amritsar	35	4	90%
Adampur	0	1	0%
Bikaner	1	1	50%
Air force station Lucknow	1	0	100%
Bhuntar	1	1	50%
Bathinda	0	2	0%
Bareilly	0	1	0%
Chandigarh	77	14	85%
Dehradun	31	5	86%
Delhi	499	46	92%
Gaggal	2	3	40%
Gwalior	2	3	40%
Jodhpur	3	3	50%
Jaipur	85	15	85%
Jaisalmer	2	1	67%

	Compliant	Non Compliant	% Compliant
Jammu	10	5	67%
Ludhiana	0	1	0%
Leh	6	4	60%
Lucknow	58	15	79%
Pathankot	0	1	0%
Pantnagar	2	0	100%
Shimla	0	1	0%
Srinagar	56	15	79%
CHENNAI FIR (91%)*	Compliant	Non Compliant	% Compliant
Hal Bangalore	3	0	100%
Bangalore	323	24	93%
Belgaum	2	0	100%
Vijayawada	26	2	93%
Coimbatore	81	3	96%
Kochi	106	9	92%
Calicut	4	0	100%
MOPA Goa	74	6	93%
Gulbarga	1	0	100%
Goa	157	23	87%
Hubli	4	0	100%
Shamsabad, Hyderabad	208	23	90%
Begumpet Hyderabad	1	0	100%
Vidyanagar	3	0	100%
Kannur	11	0	100%
Madurai	14	3	82%
Mangalore	27	3	90%
Chennai	206	19	92%
Mysore	2	1	67%
Nanded	1	1	50%
Port Blair	12	4	75%
Pondicherry	0	1	0%
Rajahmundry	3	1	75%
Sindhudurg	3	0	100%
Tuticorin	3	0	100%
Tirupati	1	0	100%
Tiruchirappally	11	1	92%
Thiruvananthapuram	48	1	98%
Visakhapatnam	9	4	69%

FIR wise compliance rate (decimals rounded off to nearest integer value).

Note: The above list contains only those airports which had flights to the Constrained Airport and are affected by ATFM measures.

Airports with % compliance less than the average compliance(87%) for the month are highlighted in red.

V. CTOT Compliance rate – Airlinewise
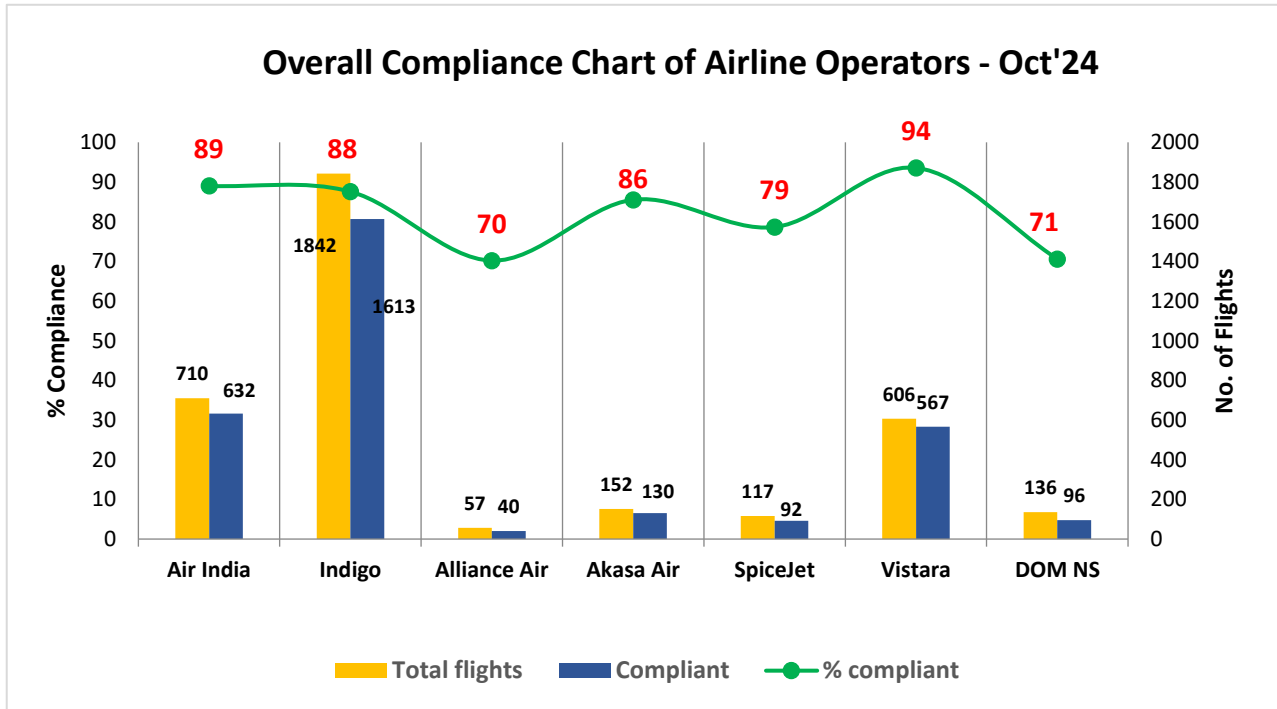
Figure 13: Airline wise Compliance –Oct'24

Inference

1. Chennai region record the highest compliance of 91% whereas Mumbai region has the lowest percentage compliance of 80%.
2. Air India, Indigo and Vistara Airlines have a CTOT compliance higher than the average recorded compliance for the month of October'24.

VI. Reason For Non Compliance
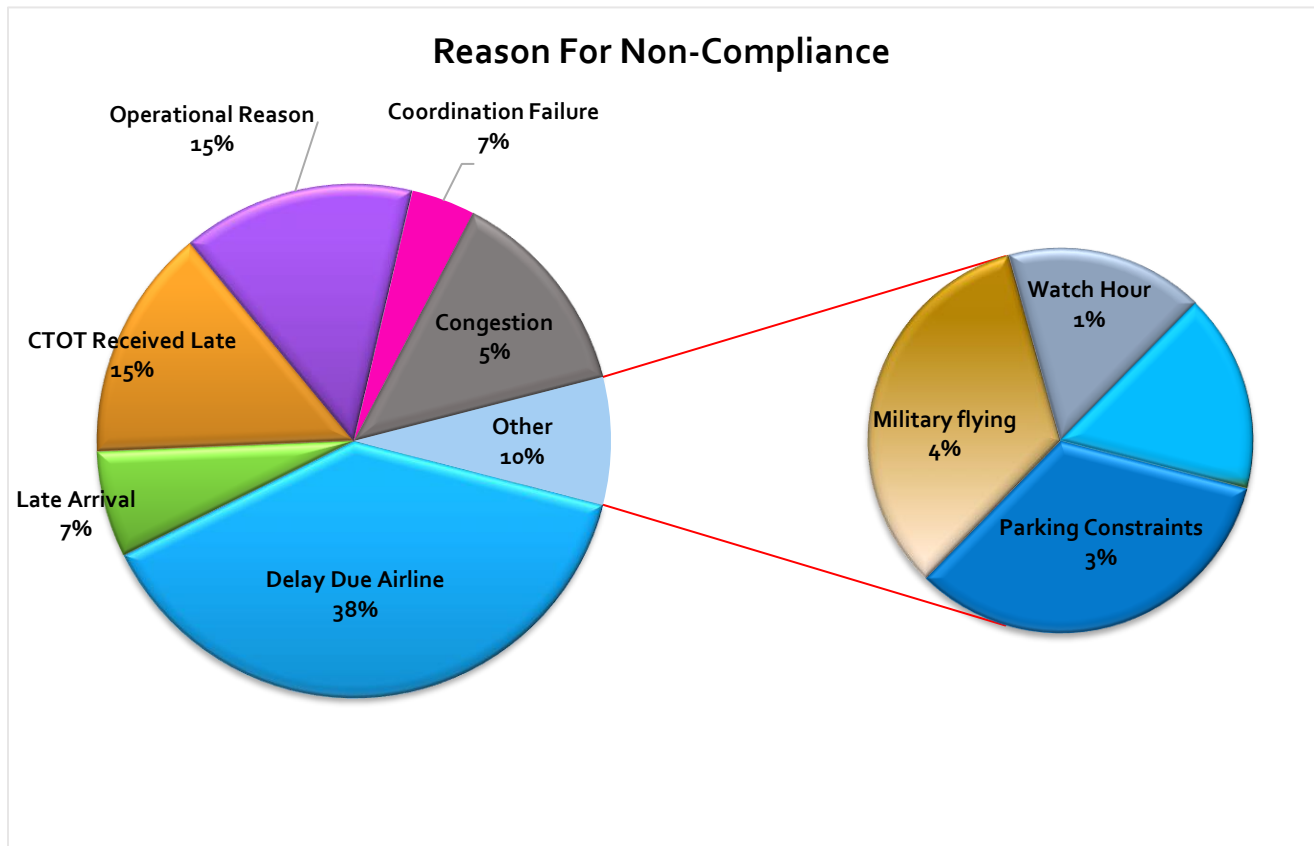
Figure 14: Reason for Non-Compliance as provided by FMPs

Inference:

1. 38 % of CTOT Non- Compliance was reported by concerned FMPs to be due to delay by Airlines.
2. 15 % of the CTOT Non- compliance was reported by concerned FMPs to be due to late receipt of CTOTs and by the time the aircraft had already initiated pushed back or startup.
3. 15 % of the CTOT Non- compliance was reported due to operational reasons at airports while 7% non - compliance was due to late arrival from previous station. Updated EOBTs of such flights was not available to ATFM unit leading to wastage of unused slots.

VII. Air Delay during the CDM Scenario period

Average Air Delay to domestic arrivals* within the CDM Scenario period for Bengaluru,Chennai, Delhi, Kolkata and Mumbai was 7.1,6.5,15.7,3.7 and 15.6 minutes respectively.

*Note: Only calculated for domestic arrivals with both ATOT and ALDT information

Air Delay during the ATFM Measure
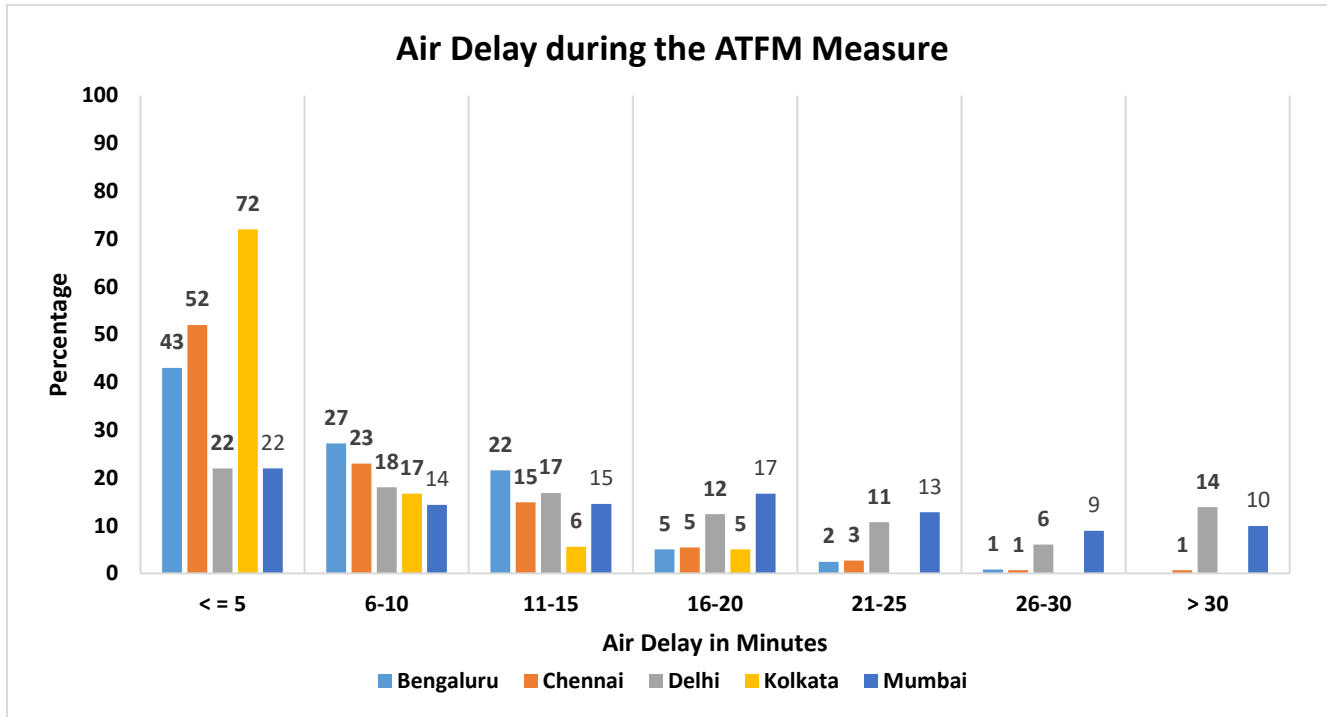
Figure 15: Air Delay distribution during the CDM period

Inference

1. 70% of domestic arriving flights to Bengaluru had an Air delay of equal to or less than 10 minutes during the CDM period.
2. 75% of domestic arriving flights to Chennai had an Air delay of equal to or less than 10 minutes during the CDM period.
3. 40% of domestic arriving flights to Delhi had an Air delay of equal to or less than 10 minutes during the CDM period.
4. 89% of domestic arriving flights to Kolkata had an Air delay of equal to or less than 10 minutes during the CDM period.
5. 36% of domestic arriving flights to Mumbai had an Air delay of equal to or less than 10 minutes during the CDM period.

VIII. Tangible Benefits due to ATFM Measures

A modest attempt is made to find out the tangible benefit of ATFM measures applied.

Assumptions:

•When ATFM measures are not in force, all flights take off at their 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 SKYFLOW using the Flight Plan information and Basic Aircraft data.

Methodology:

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.

i.e. **Total Air Delay = ∑ (Actual Flying time – SKYFLOW calculated EET)**

Air delay (with no ATFM measures) is calculated as the sum of Air delay for all the flights during the above said period with no ATFM measures in place and 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) = **∑ (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 ELDT = ETOT + SKYFLOW calculated Flying time

Fuel Saving Calculation :

Great Circle Distance(GCD)* was calculated for all the arrivals during the ATFM Measure from the point of origin to destination. Assuming Airbus 320 as reference aircraft for flights (flight distance equal to or less than 3000 nm) and B777 for international flights (flight distance more than 3000nm):

Fuel consumption (Kgs / nm) 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.

The Fuel consumed per minute(Kg/min) was calculated for each affected flight.

Total Air Delay(with ATFM Measures)= 63980 mins

Total Air Delay (with no ATFM measures) = 114701 mins

Reduction in Air delay due to ATFM measures= (114701-63980) = **50721 mins**

Fuel Saving Calculation:

Total Fuel saved during the ATFM Measure: ***30,65,867.48 Kg***

***Total reduction in CO$_2$ emission : 3.16(KgCO$_2$/kg fuel)* 30,65,867.48** Kg = 96,88,141.22 Kg*

GCD (Great Circle Distance): The distance between origin and destination airports is derived from latitude and longitude coordinates originally obtained from ICAO Location Indicators database.

3.16 = constant representing the number of tonnes of CO2 produced by burning a tonne of aviation fuel.

D. Glossary

ATFM Parameters	**Definition**
Affected Flight statistics	An insight of participating traffic in the scenario i.e. ratio of the domestic arrivals to the constrained airport affected by ATFM measures (assigned delay by the Ground Delay Program) to the domestic arrivals not affected by ATFM measures (not assigned any delay) within the CDM scenario.
ATFM Ground delay	ATFM ground delay defined as CTOT-ETOT (Calculated take off time – Estimated take off time)
Average ATFM delay	$$\frac{\textit{Total monthly ATFM delay }(\textit{in minutes})}{\textit{Total Domestic Arrivals}}$$
Maximum ATFM delay	Maximum ATFM delay (in minutes) assigned in the month
Overall compliance rate	Defined as monthly ATFM departure slot adherence rate of regulated flights. Flights having ATOT within theATFM Slot Tolerance Window (STW) of minus 5 to plus 10 minutes of CTOTs, are considered as compliant flights
CTOT Compliance rate of Airline operators	An overview of CTOT compliance rate of various Airline operators
CTOT Compliance rate of Airports within different Regions	An overview of CTOT compliance rate of Airports within 4 FIRs
Air delay statistics	Air delay defined as difference between AET & EET, whereAET(actual elapsed time) can be obtained from (ALDT-ATOT) and estimated elapsed time(EET)can be obtained from FPL/RPL or (CLDT-CTOT). **Therefore, Air delay = AET-EET** Average Air Delay is calculated as: $$\textit{Average Air Delay} = \frac{\textit{Total Air Delay to domestic arrivals }(\textit{with values greater than zero})}{\textit{Total Domestic Arrivals}}$$ *CLDT: Calculated Landing Time* *CTOT: Calculated Take off Time* *ALDT: Actual Landing Time* *ATOT: Actual Take off Time*

Annexure-A

Compliance by Airlines with Flight Planning Requirements of Common Business rules(CBR)- September 2024.

I. Introduction:

Accurate and timely input in respect of flight intent is paramount to the correct traffic demand projection and eventually effective ATFM implementation. FPLs remain the main source of tactical demand prediction for ATFM systems. Early filing of error free FPL helps in improving the lead time required for ATFM measures and reduces the number of unexpected flights(pop-up). This in turn helps in improving the accuracy of demand-capacity imbalance prediction and optimizes slot utilization.
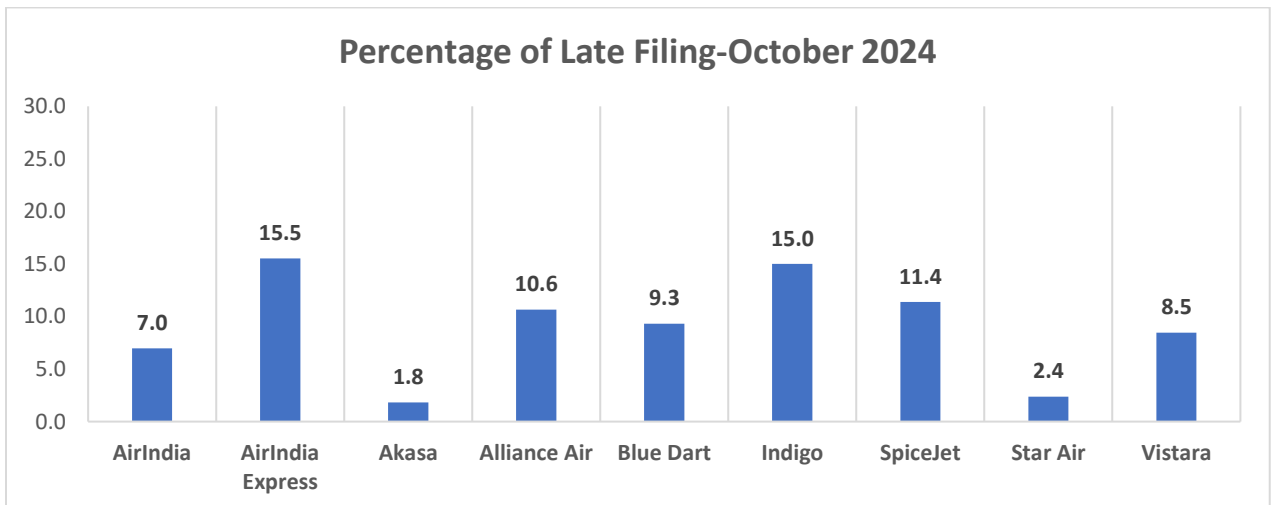
AIP India, ENR 1.9 section 4 on Flight Planning in the context of ATFM recommends Flight Planning requirements for all Airline Operators –

a) Flight plans shall be submitted at least 3 hours before the estimated off block time (EOBT);
b) The window for filing FPL is between 3 Hours and 120 Hours (Five days) before the EOBT. Earlier filing of FPL will give a realistic demand data to the CCC and hence the requirement of ATFM measures can be identified early for better planning. Late filing of a flight plan will lead to inaccuracies in predicting the demand and may lead to undesirable delay;"

II. Analysis

A. An analysis has been conducted to find out the difference between the flight plan filing time and filed EOBT for all the FPLs received at ATFM system from 1st October 2024 to 31st October 2024.
The purpose of the analysis is to monitor the compliance with provisions of AIP India, section 4, ENR 1.9 regarding Flight Planning requirements in context of the ATFM.

This flight plan filing requirement has been reiterated through the recently agreed ATFM common business rules (CBR) document and is recognized as a metrics to be monitored regularly for any improvement.

Percentage of Late Filing-October 2024

| Airline	Percentage
AirIndia	7.0
AirIndia Express	15.5
Akasa	1.8
Alliance Air	10.6
Blue Dart	9.3
Indigo	15.0
SpiceJet	11.4
Star Air	2.4
Vistara	8.5

The table below lists number of filed flight plans (FPLs) with less than 3 Hours prior to EOBT:

Name of Airline	Late Filed FPL	Total No. Of FPL	% Delayed Filing
AirIndia	1020	14669	7.0
AirIndia Express	1977	12722	15.5
Akasa	76	4178	1.8
Alliance Air	254	2387	10.6
Blue Dart	60	645	9.3
Indigo	7202	66966	15.0
SpiceJet	454	3989	11.4
Star Air	30	1263	2.4
Vistara	875	10325	8.5
Total no. of FPLs for Scheduled Airlines	**11948**	**117144**	**10.2**

B. For the analysis of non-receipt of DLA (Delay) messages for flight plans filed, the EOBT of FPL received has been compared with Actual Take off time (ATOT)received through DEP(Departure)messages.
Thus, only those FPLs were considered for analysis for which DEP messages were available and no associated DLA messages was received.

The Table below lists number of flights for which no DLA message was received in October 2024. **{(EOBT of original FPL)- (ATOT received)} > 30 minutes)**

Name of Airline	DLA Message not received	Total No. of flights considered for analysis	% of flights for which no DLA message was received
Air India	3184	12220	26.1
Akasa Air	952	3317	28.7
Air India Express	3051	9544	32
Blue dart	174	564	30.9
Indigo	12084	52965	22.8
Alliance Air	401	1379	29.1
Star Air	119	526	22.6
Spice Jet	855	3141	27.2
Vistara	2700	8661	31.2

Percentage of DLA Msg not received-October 2024
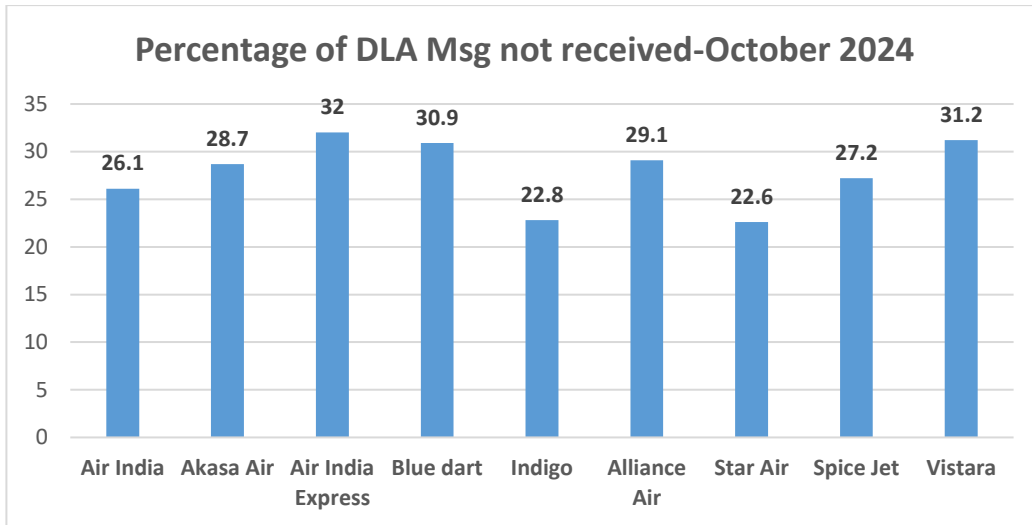
C. For analysis of non-receipt of CNL (cancel) messages for October 2024, annulled FPLs were considered for which no CNL/DEP/DLA messages were received. A FPL gets annulled in SKYFLOW system, if it doesn't get activated through Dep message /surveillance data/ manual activation by FMP within a defined system parameter.

The table below lists the number of Flights for which no CNL Msg. was received in October 2024:

Name of Airline	CNL message not received	No. of flights annulled
Air India	18	99
Akasa Air	6	34
Air India Express	48	133
Blue dart	6	10
Indigo	78	254
Alliance Air	160	171
Star Air	27	49
Spice Jet	53	97
Vistara	65	102

-X-

-End of Report-