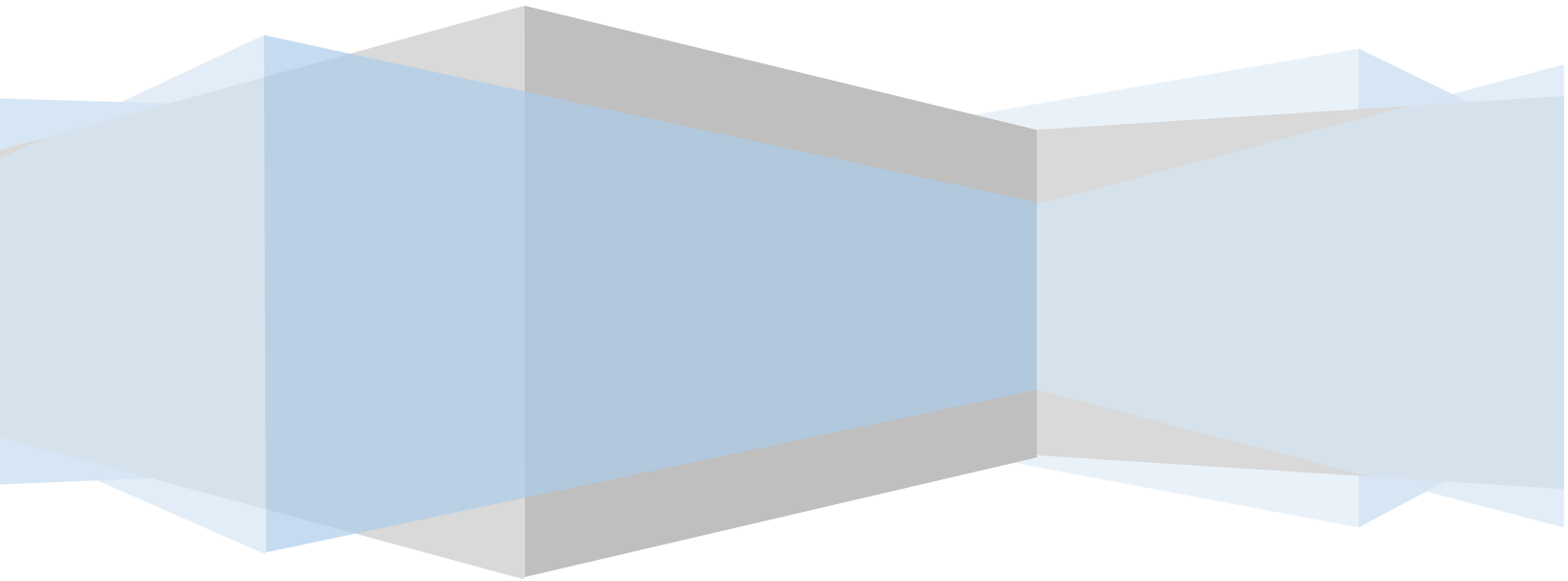


# POST OPERATIONS ANALYSIS REPORT

March,2022

CENTRAL COMMAND CENTER, C-ATFM, DELHI







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## A. Executive Summary

Amidst declining cases of Covid-19 infections, Government of India decided to resume scheduled commercial international passenger flights to and from India from 27<sup>th</sup> March’22 coinciding with the beginning of the new Summer Schedule.

All Six Metro Airports saw an increase in the daily average air traffic movement as compared to the previous month.

Only One(1) ATFM measure was applied this month to regulate traffic landing at Delhi Airport owing to increased demand.

On average, the Indian Airports in the ATFCM area saw 3483 IFR flights per day. The peak day was on 16<sup>th</sup> Mar’22 (3868 IFR flights). Monday’s were the busiest days throughout this month with an average of 3637 flights per day. Major Airports -Delhi, Mumbai, Bengaluru, Kolkata, Chennai and Hyderabad recorded average daily movements 96%,95%, 81%, 78%,71% and 79% respectively of March 2019 levels.

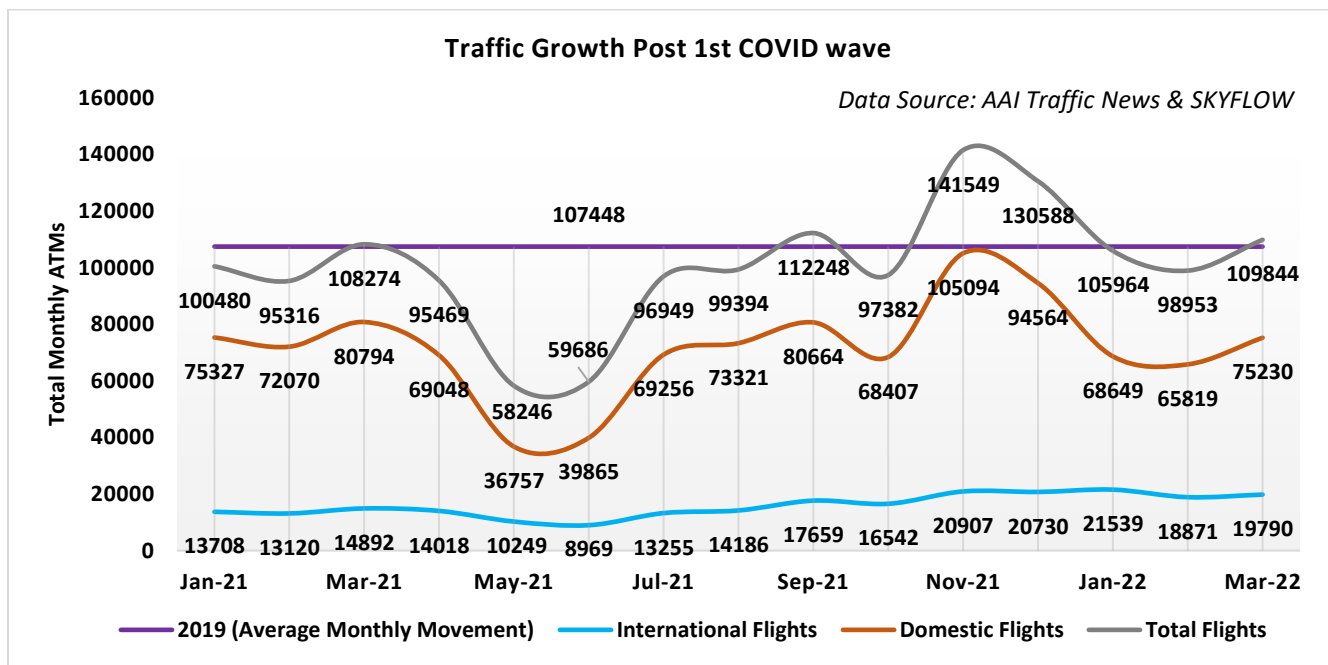


Figure 1: Traffic Growth Post 1<sup>st</sup> COVID wave

The graph above depicts the Domestic and international Air traffic in Indian ATFCM Area during the last 15 months (Jan’ 2021 to March’2022). The traffic demand is visibly impacted by the Covid-19 infections through out the period.



## B. Traffic Analysis

### I. Air Traffic Movement at 4 Major Airports in India

Air Traffic Movement for each day of the month of March'22 is plotted for Delhi, Mumbai, Bengaluru and Hyderabad Airport along with the percentage change w.r.t. movement on 1<sup>st</sup> March'22.

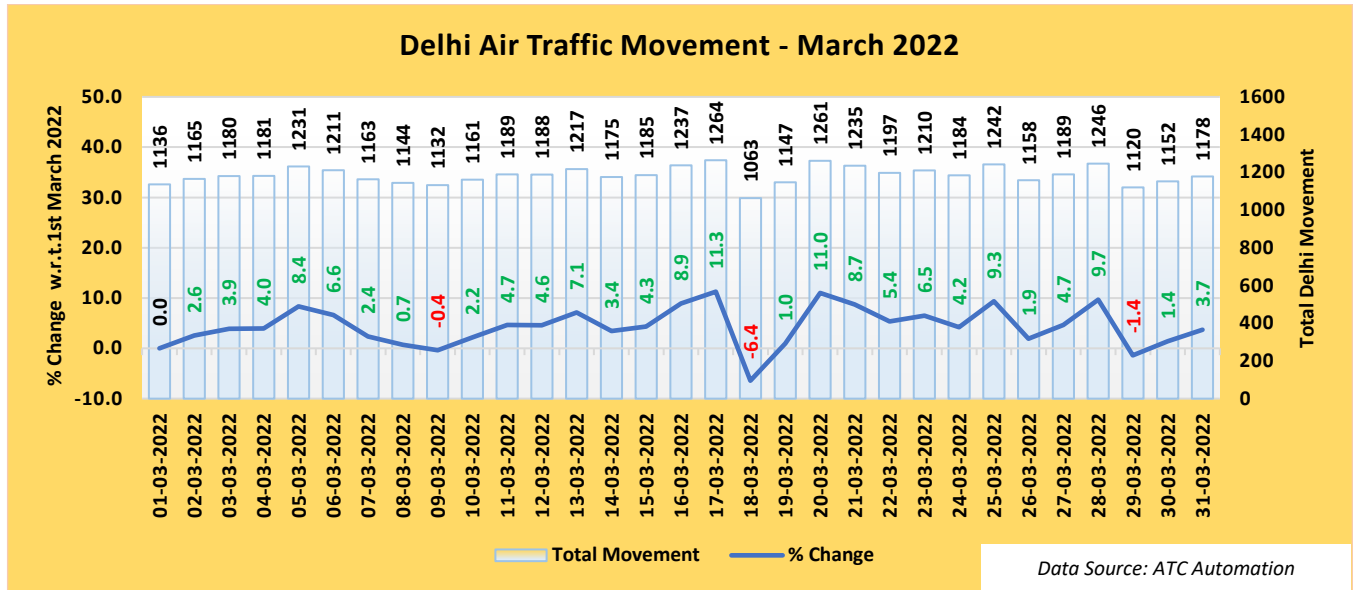


Figure 2: Air Traffic Movement for Delhi – March 2022

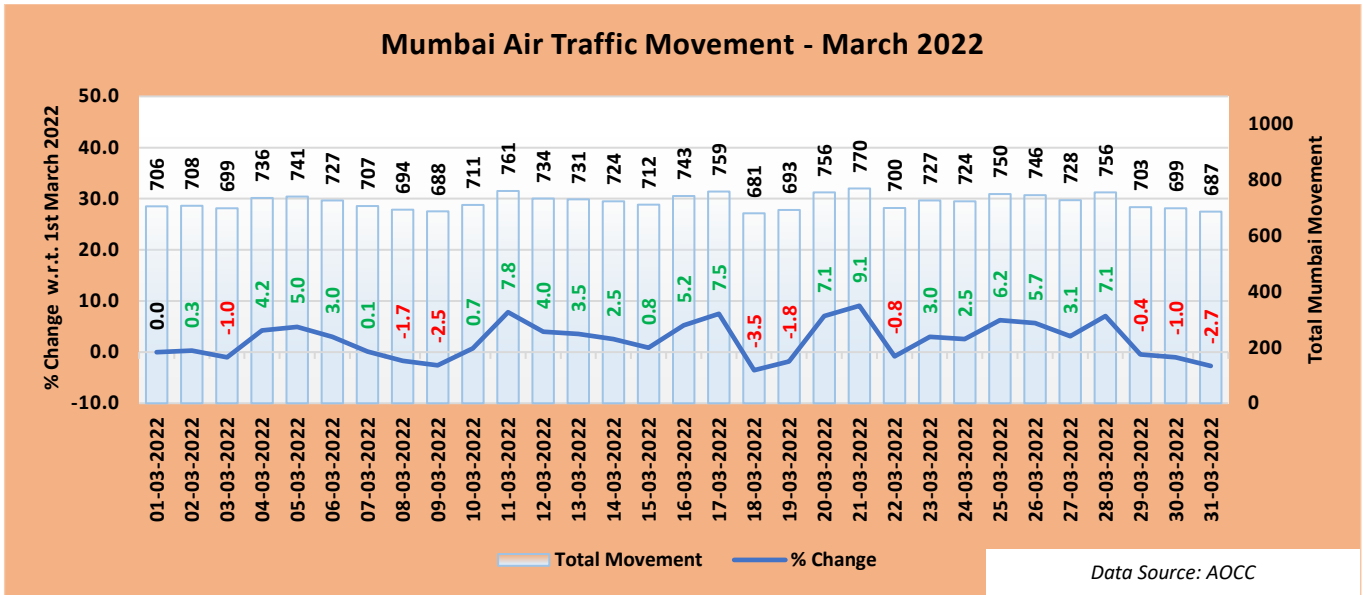


Figure 3: Air Traffic Movement for Mumbai - March 2022

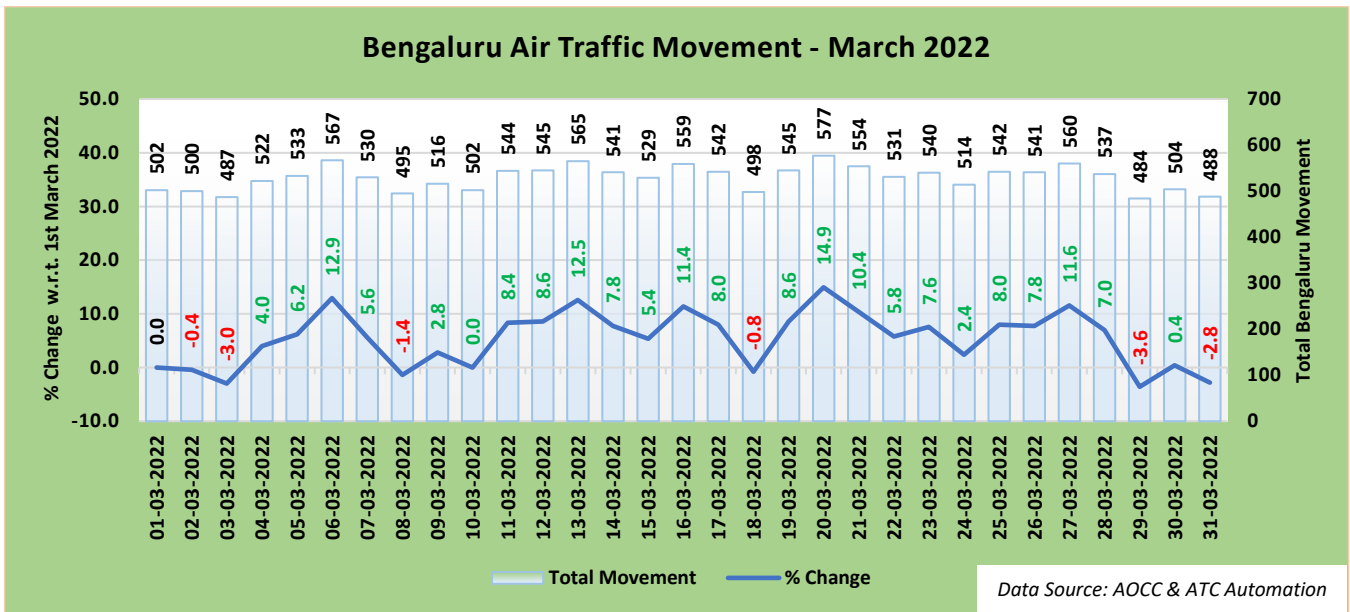


Figure 4: Air Traffic Movement for Bengaluru - March 2022

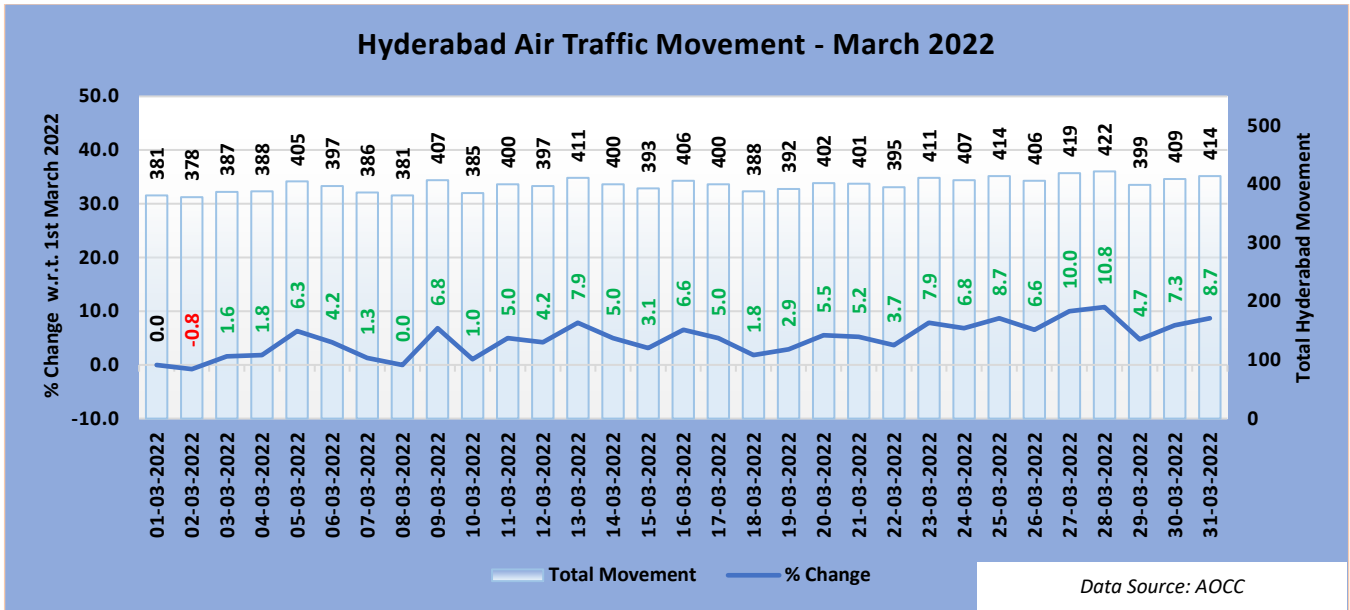


Figure 5: Air Traffic Movement for Hyderabad - March 2022

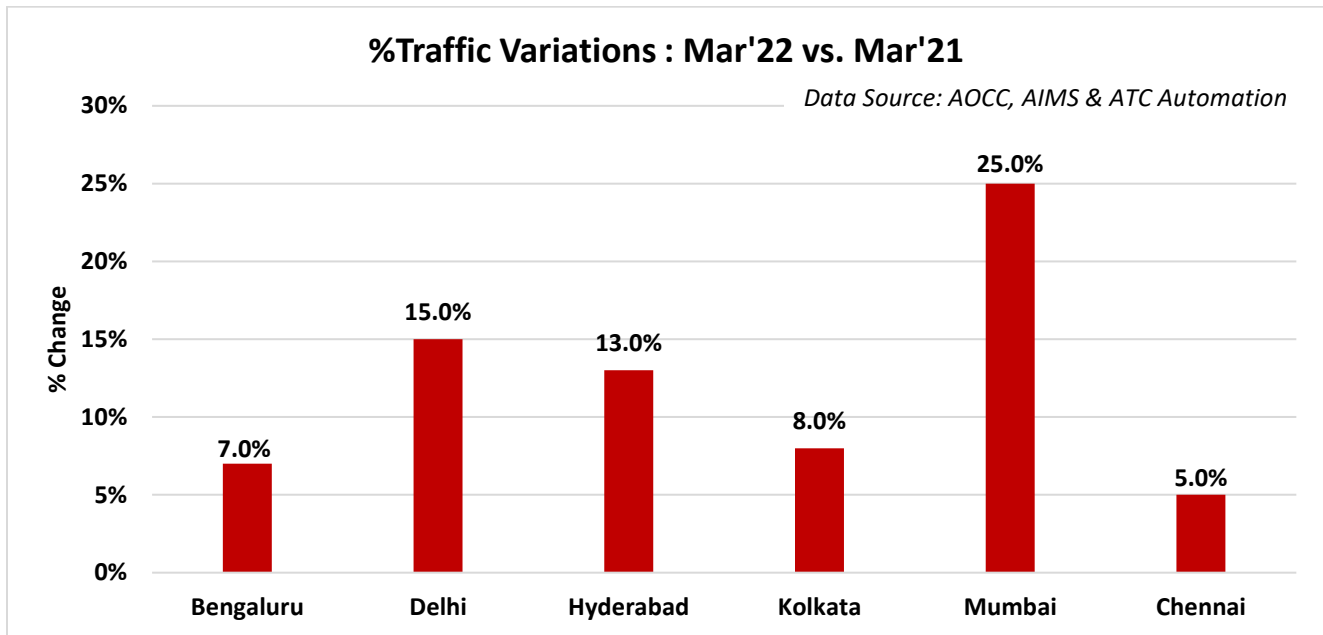
It is evident from the above charts that the air traffic has seen a marginal improvement in case of Delhi and Hyderabad airports with upto 3.7% and 8.7% increase respectively and a slight decline in case of Mumbai and Bengaluru airports with 2.7% and 2.8% decrease respectively on 31<sup>st</sup> March'22 as compared to the Air Traffic movement on 1<sup>st</sup> March'22.





## II. Comparison of total ATMs (YoY) and Monthwise

The total Air traffic movement including Passenger and Combination of other flights i.e. All-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 March for two consecutive years. Air Traffic movement is also plotted Airline wise for the last six months for the major Scheduled Operators.



**Figure 6: Percentage Traffic Variation (YoY)**

Airports\Year	Total ATMs (YoY) for six major airports	
	Mar'22	Mar'21
Bengaluru	16394	15328
Delhi	36741	31767
Hyderabad	12381	10940
Kolkata	11067	10265
Mumbai	22401	17888
Chennai	10145	9651

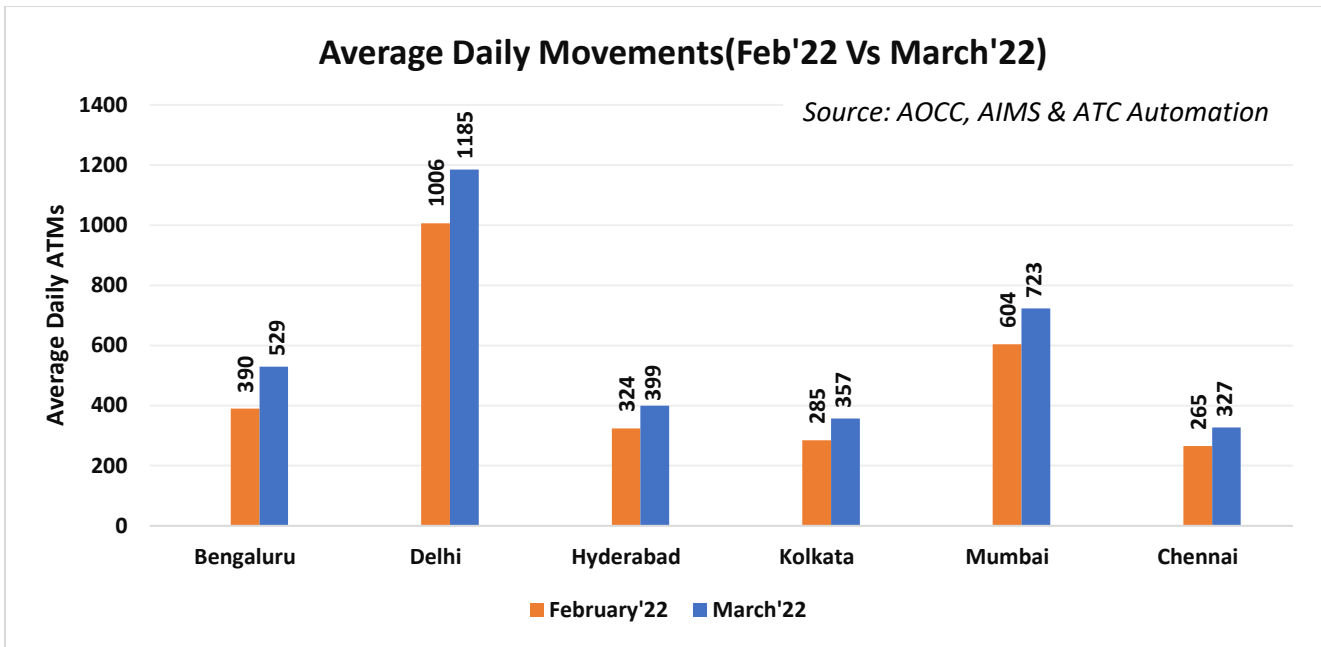


Figure 7: Average Daily Movements(Feb'22 vs March'22)

### III. Flight Operations – Airlinewise

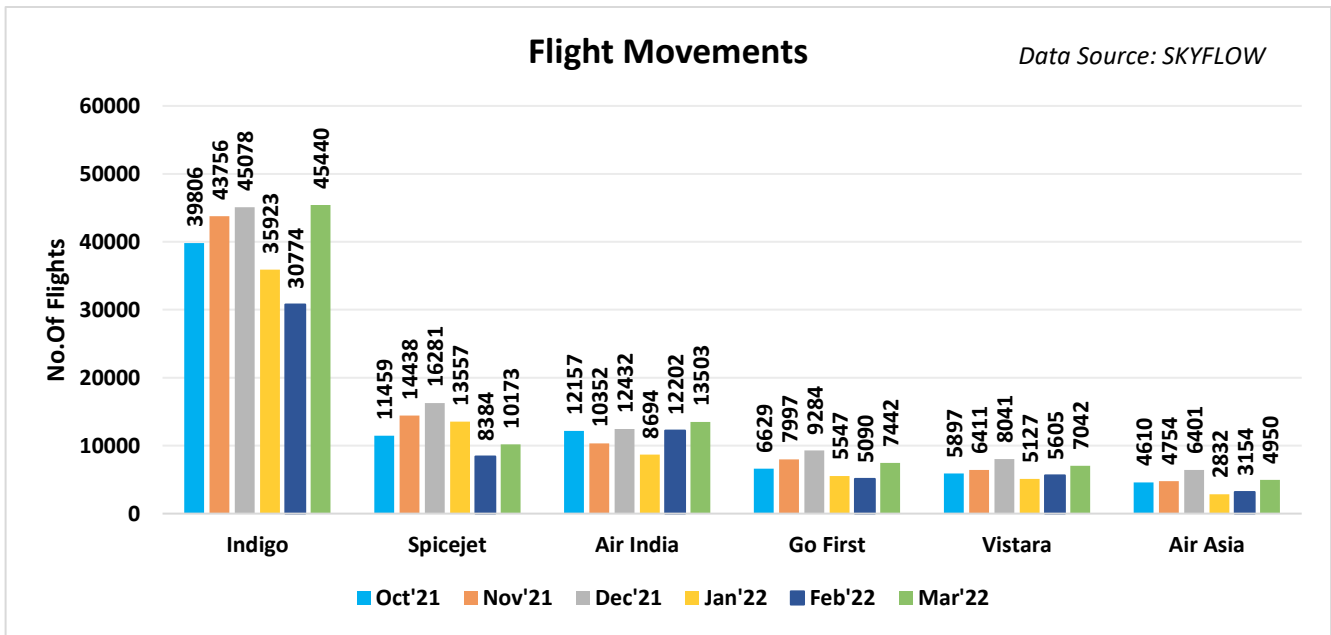


Figure 8: Flight Movements –Airlinewise



## C. ATFM Post Operations – CDM Analysis

### I. Introduction

**Analysis Period** 1<sup>st</sup> – 31<sup>st</sup> March'22

**Back Ground** During the above mentioned period, **one(1)** ATFM measures was applied **for Delhi Airport** due to the following reason as illustrated in the bar chart below:–

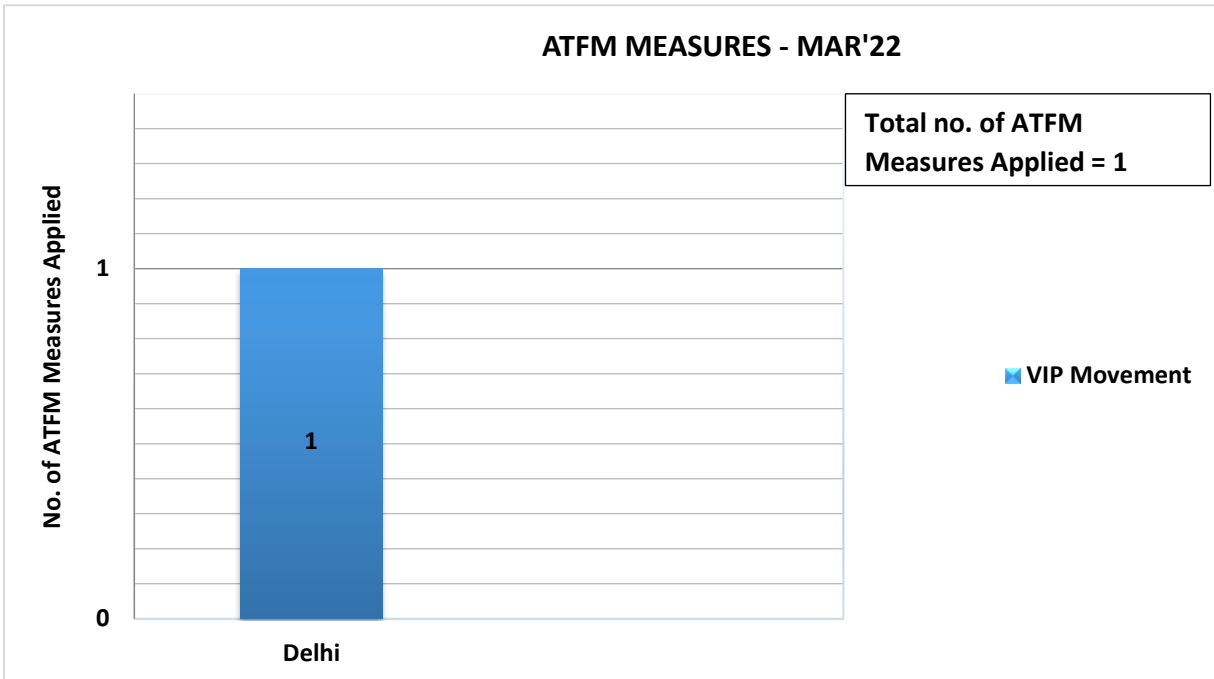


Figure 9: ATFM Measures –Mar'22



## II. ATFM Measures Overview

Constrained Airport	Delhi Airport
Number of ATFM measures applied	1
Average ATFM Ground delay due to measures*	16 Min
Maximum ATFM Ground delay due to measures	30 Min
% Compliance	75

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

Total Arrivals	71
Total International Arrivals(Exempted)	10
Total affected flights in scenario (Domestic Arrivals)	61
Total Domestic Arrivals with zero ATFM delay	3
Total Domestic Arrivals with ATFM delay	58

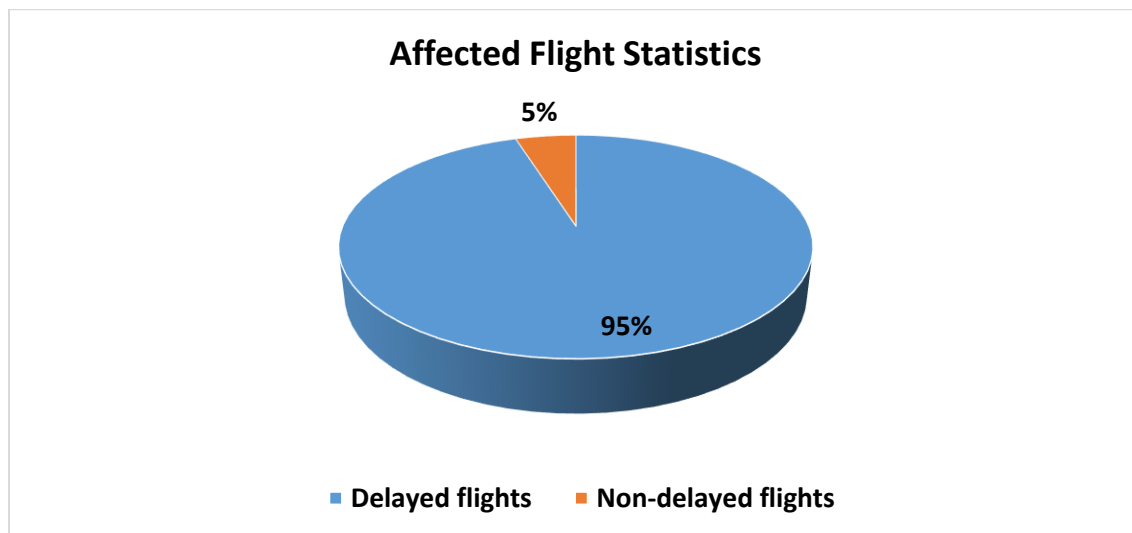


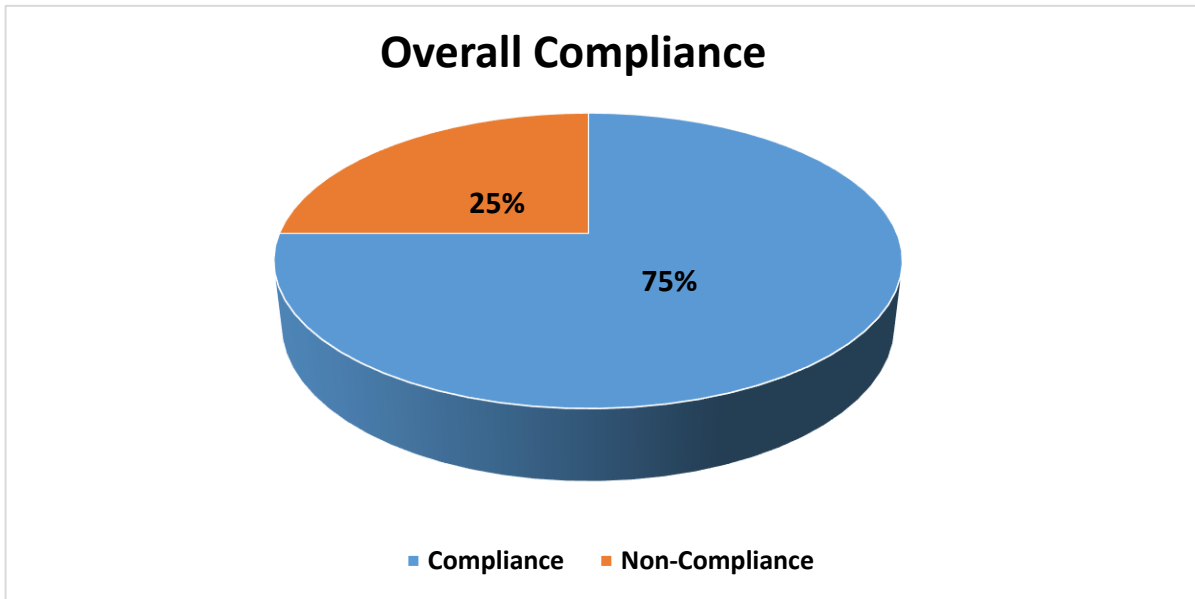
Figure 10: Affected Flight Statistics –Mar'22



### III. Overall Compliance

<b>Total arrivals</b>	71
<b>Domestic arrivals</b>	61
<b>Flights with complete data (ATOT)</b>	60
<b>Flights with incomplete data</b>	1
<b>Flights Not Operated</b>	0
<b>Compliant*</b>	45
<b>Non-Compliant</b>	15

\*Total No. of Revised CTOTs issued = 9 (Compliance calculation for flights which were issued revised CTOT is w.r.t. new CTOT issued)



**Figure 11: Overall Compliance – Mar’22**

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

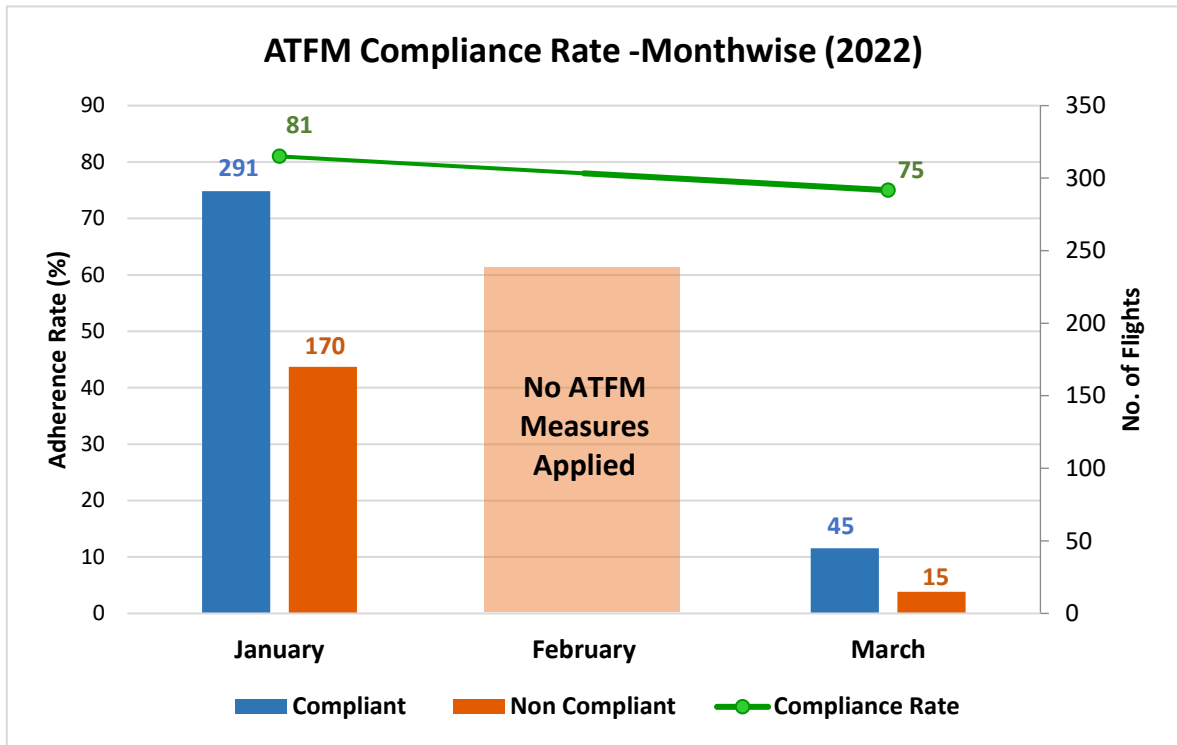


Figure 12: ATFM Compliance(YoY)

### Inference

1. Out of the total arrivals captured for the constrained Airports during the CDM scenario, 86% of flights i.e. Domestic arrivals, are participating.
2. Out of these Domestic Arrivals, 95% of arrivals are assigned ATFM ground delay.
3. Out of the total arrivals captured to the constrained Airport during the ATFM scenario, 82% of flights are assigned ATFM Ground Delay.



## IV. CTOT Compliance rate – Airportwise

MUMBAI FIR (93%)*	Compliant	Non Compliant	%Compliant
Pune	2	0	100
Mumbai	5	1	83
Jabalpur	2	0	100
Aurangabad	1	0	100
Udaipur	1	0	100
Nagpur	1	0	100
Surat	1	0	100
<b>KOLKATA FIR (78%)*</b>			
Varanasi	1	1	50
Kolkata	2	0	100
Bagdogra	3	1	75
Dimapur	1	0	100
Gorakhpur	0	1	0
Guwahati	2	1	66
Prayagraj	1	0	100
Darbangha	1	0	100
Raipur	1	0	100
Imphal	1	0	100
Patna	1	0	100
<b>DELHI FIR (58 %)*</b>			
Chandigarh	1	0	100
Dehradun	1	0	100
Jodhpur	1	0	100
Jammu	3	0	100
Jaipur	2	0	100
Lucknow	1	2	33
Srinagar	2	6	25
<b>CHENNAI FIR (78%)*</b>			
Goa	3	0	100
Bengaluru	1	0	100
Chennai	2	0	100
Shamshabad	1	1	50
Vishakhapatnam	0	1	0

\*FIR wise compliance rate

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



## V. Reason For Non Compliance

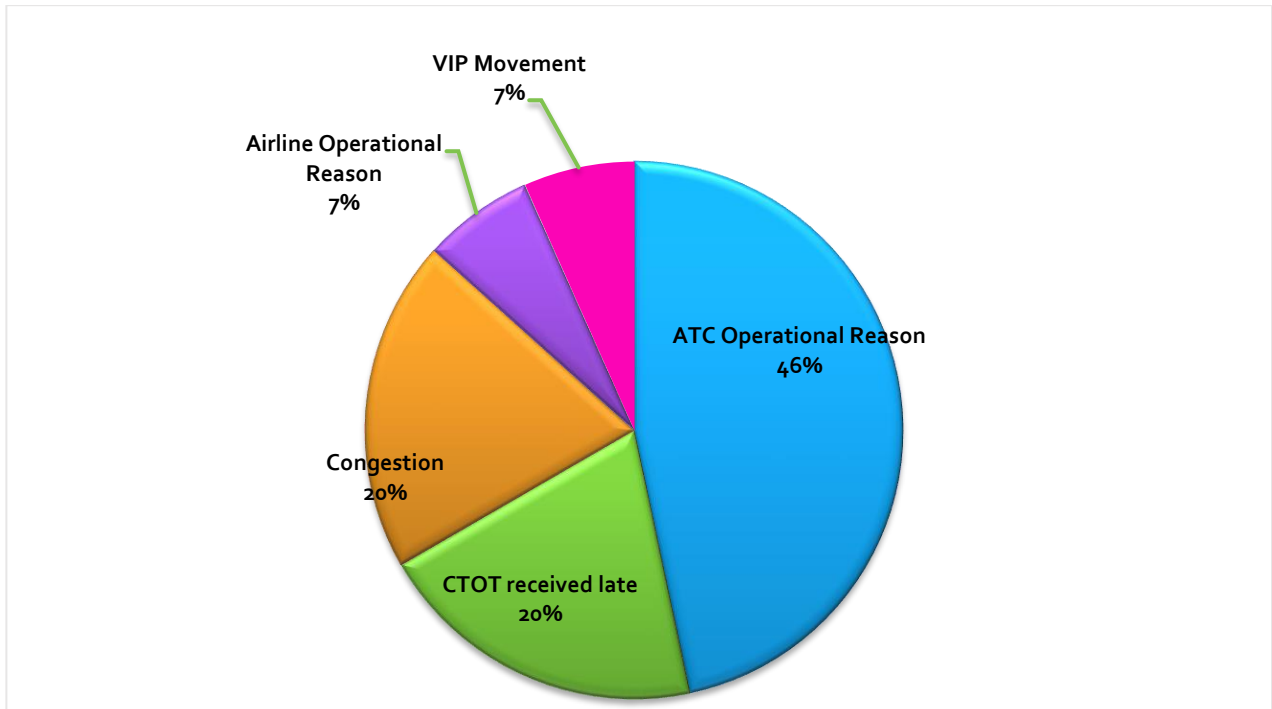


Figure 13: Reason for Non-Compliance as provided by FMPs

### Inference

1. ATC Operational Reason is one of the biggest factor identified by FMPs as a reason for Non-Compliance from their station.
2. Congestion at the place of departure is also identified as a major reason for Non compliance.
3. CTOT was received late at the place of departure and by that time the flight had already initiated a pushback/startup is another major factor identified by FMP.





## VI. CTOT Compliance rate – Airlinewise

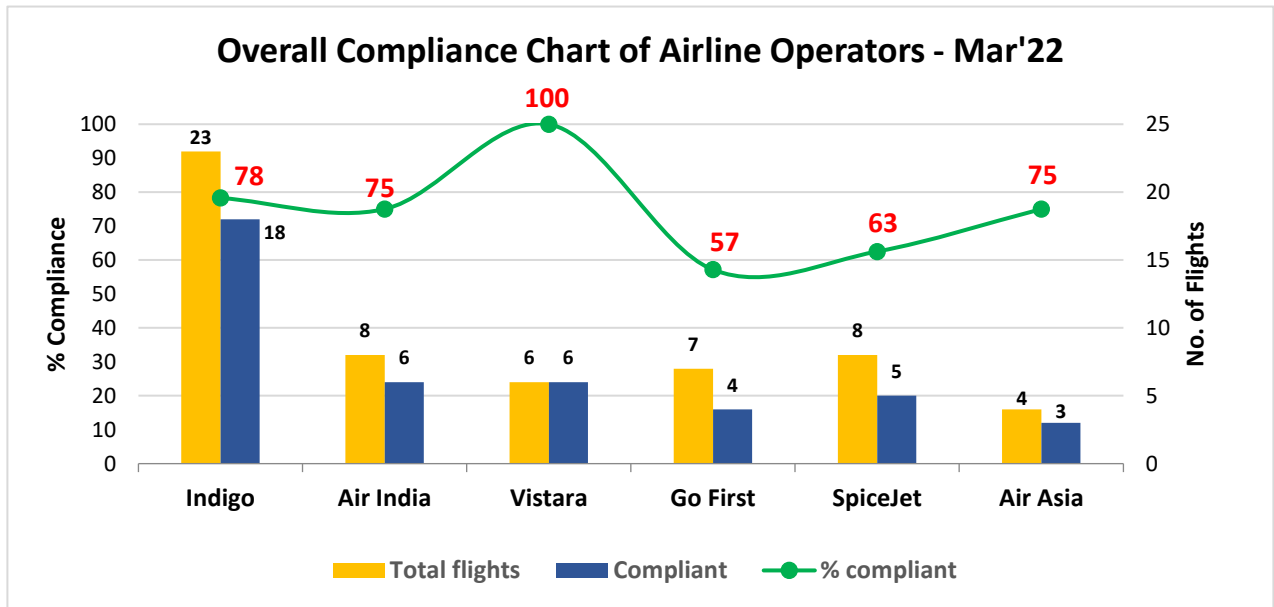


Figure 14: Airlines Overall Compliance –Mar’22

### Inference

1. Out of the total domestic arrivals with complete data in the CDM scenario, 75% arrivals are compliant.
2. Delhi region has the lowest compliance rate of 58% whereas Mumbai region have the highest compliance rate of 93%.
3. Vistara and Indigo Airlines have a CTOT Compliance better than the average recorded compliance for the month of Mar’22.
4. Air India and Air Asia have a CTOT Compliance equal to the the average recorded compliance for the month of Mar’22.



## VII. Air Delay during the CDM Scenario period

Average Air Delay to domestic arrivals\* within the CDM Scenario period for Delhi is 3 minutes.

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

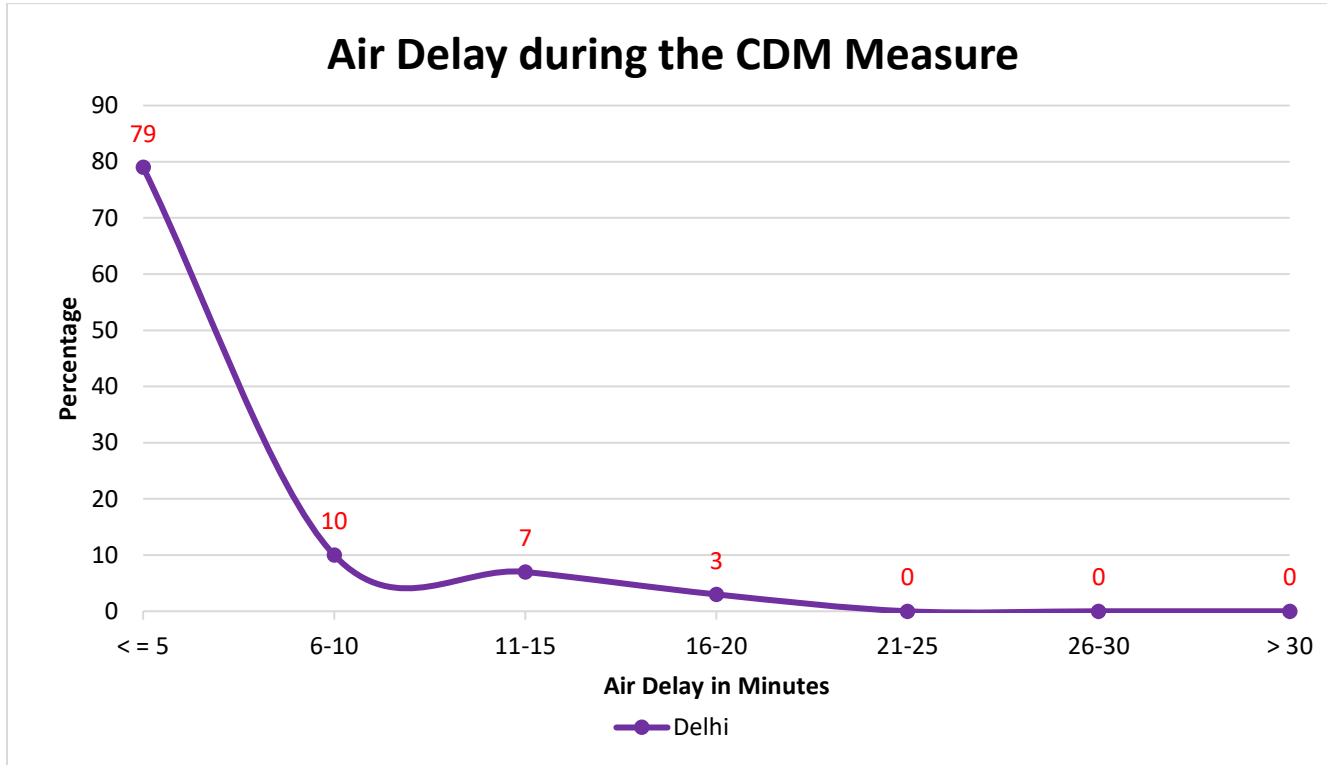


Figure 15: Air Delay distribution during the CDM period

### Inference

1. 96% of domestic arriving flights to Delhi had an Air delay of equal to or less than 15 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.

A study was conducted to calculate Fuel Saving due to ATFM measures on 2<sup>nd</sup> Mar'22 (1200-1400 UTC) due to the reduction in Air delay by the application of Ground Delay measures.

### 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 Delhi Airport.

i.e. **Total Air Delay =  $\sum$  (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) =  $\sum$  (Ideal LDT - Ideal ELDT)**

\*Ideal LDT is taken by assuming every flight is landing at Delhi with alternate spacing interval of 110 sec in the 1<sup>st</sup> hour of the CDM and 90 sec in the 2<sup>nd</sup> hour.

\*Ideal ELDT = ETOT + SKYFLOW calculated Flying time

### Fuel Saving Calculation during the CDM Period 02.03.2022 (1200 UTC to 1400 UTC):

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 for domestic flights (flight distance less than 1500 nm) and B777 for international flights (flight distance more than 5000nm):

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) = -44 min\*

\*Runway change prior to VIP movement provided a straight in approach to almost 41% of flights coming from the east and hence lesser Air delay.

Total Air delay (with no ATFM measures) = 926 min

Total amount of Air delay reduced due to ATFM measures=  $926 - (-44) = 970$  min

**Fuel Saving Calculation:**

Total Fuel saved during the ATFM Measure: **55078.61 Kgs**

**Total reduction in CO<sub>2</sub> emission :  $3.16(\text{KgCO}_2/\text{kg fuel}) * 55078.61 \text{ Kgs} = 174048.41 \text{ Kg}$**

\*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 CO<sub>2</sub> produced by burning a tonne of aviation fuel.



## D. Glossary

<b>ATFM Parameters</b>	<b>Definition</b>
<i>Affected Flight statistics</i>	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)
<i>Average ATFM delay</i>	$\frac{\text{Total monthly ATFM delay (in minutes)}}{\text{Total Domestic Arrivals}}$
<i>Maximum ATFM delay</i>	Maximum ATFM delay (in minutes) assigned in the month
<i>Overall compliance rate</i>	Defined as monthly ATFM departure slot adherence rate of regulated flights. Flights having ATOT within the ATFM Slot Tolerance Window (STW) of minus 5 to plus 10 minutes of CTOTs, are considered as compliant flights
<i>CTOT Compliance rate of Airline operators</i>	An overview of CTOT compliance rate of various Airline operators
<i>CTOT Compliance rate of Airports within different Regions</i>	An overview of CTOT compliance rate of Airports within 4 FIRs
Air delay statistics	<p>Air delay defined as difference between AET &amp; EET, where AET (actual elapsed time) can be obtained from (ALDT-ATOT) and estimated elapsed time (EET) can be obtained from FPL/RPL or (CLDT-CTOT). <b>Therefore, Air delay = AET-EET</b></p> <p>Average Air Delay is calculated as:</p> $\text{Average Air Delay} = \frac{\text{Total Air Delay to domestic arrivals (with values greater than zero)}}{\text{Total Domestic Arrivals}}$ <p>CLDT: Calculated Landing Time CTOT: Calculated Take off Time ALDT: Actual Landing Time ATOT: Actual Take off Time</p>