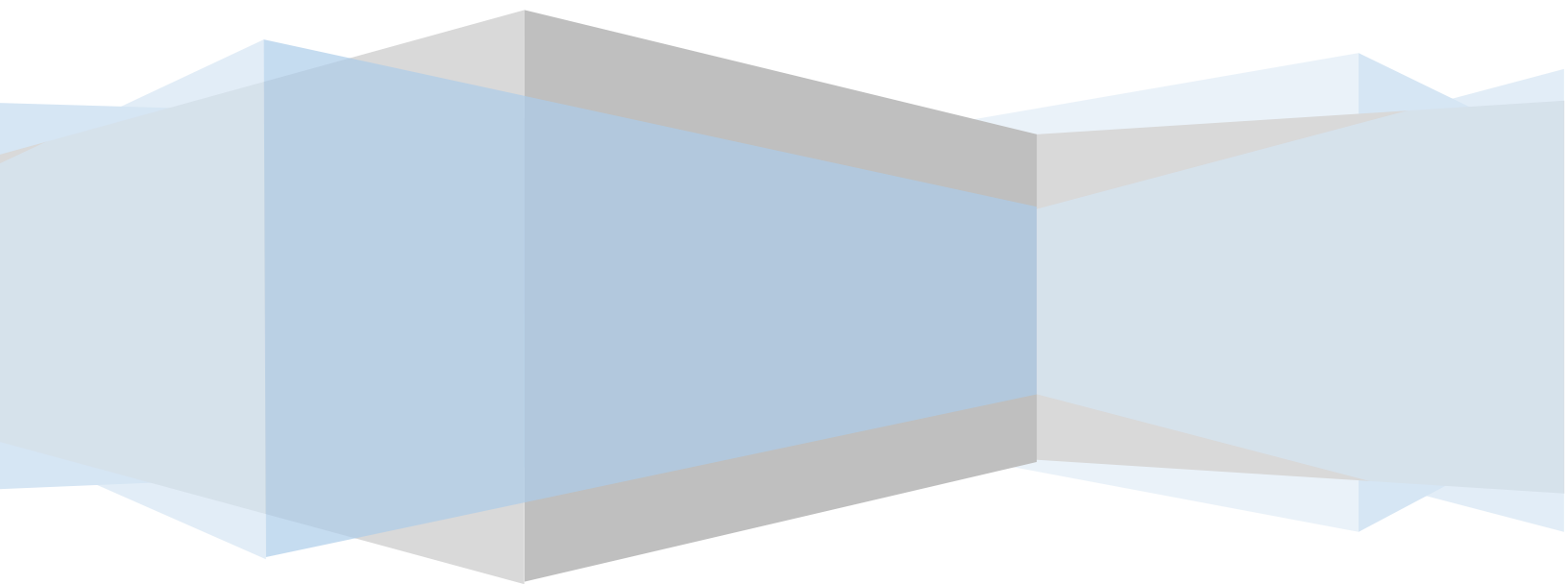


ANNUAL REPORT

ATFM OPERATIONS

(May 2017 to April 2018)

CENTRAL COMMAND CENTER, C-ATFM, DELHI





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Annual ATFM Operations Report (May 2017 – April 2018)

Introduction

Airports Authority of India (AAI), in accordance with ICAO guidelines has implemented Central Air Traffic Flow Management (CATFM). The C-ATFM system network architecture consists of a Central Command & Control Center (CCC), supported by 36 (thirty six) Flow Management Positions (FMP), located at 6 major Area Control Centers (ACC) and 30 (thirty) other major airports, which includes 8 (eight) Defence airports also.

C-ATFM in India is being implemented in phased manner, broadly in three phases. ATFM phase-I regular operation commenced from 27th April, 2017 vide AIP supplement 25/2017. During phase-I operation the Demand-Capacity scenario of six (6) major ACCs airports i.e. Delhi, Mumbai, Chennai, Kolkata, Bengaluru and Hyderabad, is regulated by applying appropriate ATFM measures available in phase I i.e. Ground Delay & Airport Stop programs. Presently, ATFM measures are applied only to Domestic arrivals to constrained Airports.

During the mentioned period, 506 (Five Hundred Six) times ATFM measures were applied for Delhi; 152 (One Hundred Fifty Two) number of times ATFM measures were applied for Mumbai, 40 (Forty) times for Bengaluru and once (1) for Chennai. It has been observed that usually imbalance occurs due to an inefficient flight scheduling system.

CCC has also conducted several training programs for stakeholders like ANSPs, Airline operators, Airport operators & Defence officers. A total of 694 ATCOs, 30 Airline personnel, 22 AOCC personnel & 197 Defence officers were trained during the mentioned period.

Journey through last twelve months in ATFM, was a learning process for CCC officers. The guidelines/Operating procedures were developed for stakeholders & CCC specialists, taking into account System/Operational constraints. These procedures were revised with the experienced gained and feedback received from stakeholders from time to time.

ATFM implementation process is a challenging task. CCC is encountering many issues like Manpower (both in terms of quantity & quality), Awareness, ATFM operational experience, customizing SKYFLOW system as per Indian aviation scenario, high expectation of stakeholders etc. ATFM stakeholders needs to address several issues like proactive participation/sharing of correct flight data/awareness & involvement/promulgation of new ATFM rules/regulations etc. to tackle current ATFM performance problem.

Analysis Period 1st May 2017 – 30th April 2018

Data source SKYFLOW, Delhi Automation system, Airport CDM data Mumbai and Bengaluru, Mumbai Automation system & feedback from stakeholders.

Data from SKYFLOW system and FMPs has been used for analysis. Where required, Delhi and Mumbai Automation System data and Bengaluru AOCC/ACDM data has been used to augment the available data. Flights with complete data i.e. ATOT(actual take off time), ATA(actual time of arrival), etc. are only taken into consideration. Out of the total domestic arrivals for which CTOTs(calculated take off time) were issued, 89.6% data has been considered for Compliance measurement. Rest 10.4% data include domestic arrivals that did not operate and flights with incomplete required information.



ATFM Parameters

1. ATFM Program Impact

- **ATFM Scenario**

(An overview of traffic scenario within CDM scenarios, representing the ratio of International traffic & domestic traffic to the constrained Airport.)

- **Affected Flight statistics**

[An insight of participating traffic in the scenario i.e. pie chart of the domestic arrivals to constrained airport affected by ATFM measures (given delay by the Airport Delay Program) and that of domestic arrivals not affected by ATFM measures (not given any delay) within the CDM scenario.]

2. ATFM Ground delay

(ATFM ground delay defined as CTOT-ETOT)

i.e. Calculated take off time- Estimated take off time

- **Total ATFM delay distribution**

(Value in minutes representing total ATFM delay)

- **Total flights affected**

(Flight count in numerical value)

- **Average ATFM delay**

(Total ATFM delay for twelve months / total number of domestic flights)

- **Maximum ATFM delay**

(Maximum ATFM ground delay assigned by the system in the last twelve months)

- **ATFM delay distribution in the band**

(No delay, 0-5, 6-10; 11-15; 16-20; >20 minutes)

(An overview of ground delay distribution in the different time bands)

3. ATFM Compliance Measurement

- **Overall compliance rate**
(Defined as monthly ATFM departure slot adherence rate of regulated flights. Flights having ATOT within the ATFM Slot Tolerance Window (STW) of CTOT i.e. -5 to +10 minutes of CTOTs, are considered as compliant flights)
- **ATFM departure slot adherence distribution**
(An overview of regulated flight departures inside an ATFM slot tolerance window [ASTW], before ASTW & after ASTW)
- **CTOT Adherence rate of Airline operators**
(An overview of CTOT compliance rate of various Airline operators)
- **CTOT Adherence rate of Regions**
(An overview of CTOT compliance rate of 4 FIRs)
- **CTOT Adherence rate of Airports within different Regions**
(An overview of CTOT compliance rate of Airports within 4 FIRs)

4. Air delay statistics

{Air delay defined as difference between Actual elapsed time (AET) & estimated elapsed time(EET), where EET can be obtained from FPL or (CLDT-CTOT) and AET can be obtained from (ALDT-ATOT)}

- **Distribution of (AET-EET) w.r.t. Compliant & non-compliant flights**
(≤ -30 ; -29 to -20; -19 to -10; -9 to -1; 0-10; 11-20; 21-30 & >31 minutes)
(An overview of Air delay distribution in the different time bands)
- **Cumulative distribution of difference (AET-EET)**

1. ATFM Program Impact

Data in this section helps to assess the impact of ATFM measure on overall flight operations in ATFM scenario & the extent of flights involved. Analysis provides:

- Picture of overall traffic mixture in the ATFM scenarios for **twelve months** and the percentage of participating flights to constrained airport.
- Percentage of participating flights given ATFM delay & its impact on overall flights in ATFM scenario.

1.1 ATFM Scenario

Total Flights	130098
International arrivals	11783
International departures	10906
Domestic arrivals	55948
Domestic departures	51461

Table-1

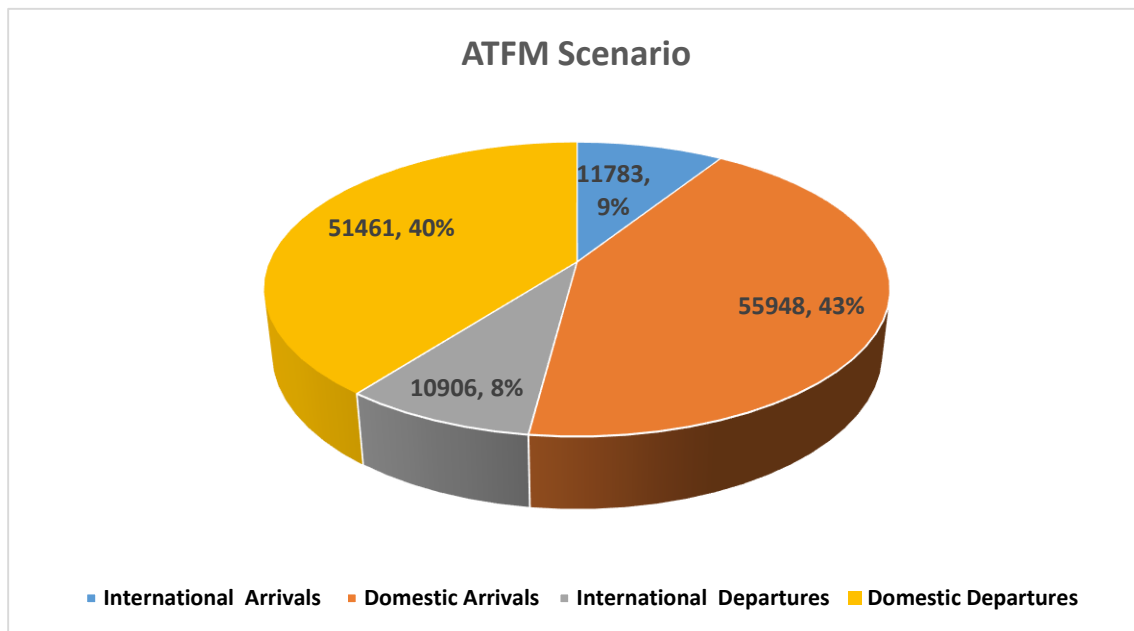


Figure 1 - ATFM Scenario

Within the CDM Scenario, domestic departures from the constrained Airport are regulated through Airport CDM. International Arrivals and Departures are exempted from ATFM measures. Only Domestic Arrivals to the constrained airport are participating.

1.2 Affected Flight Statistics

Total affected flights in scenario (Domestic Arrivals to constrained Airport)	55948
Total Domestic Arrivals with ATFM delay	43120
Total Domestic Arrivals with zero ATFM delay	12828

Table-2

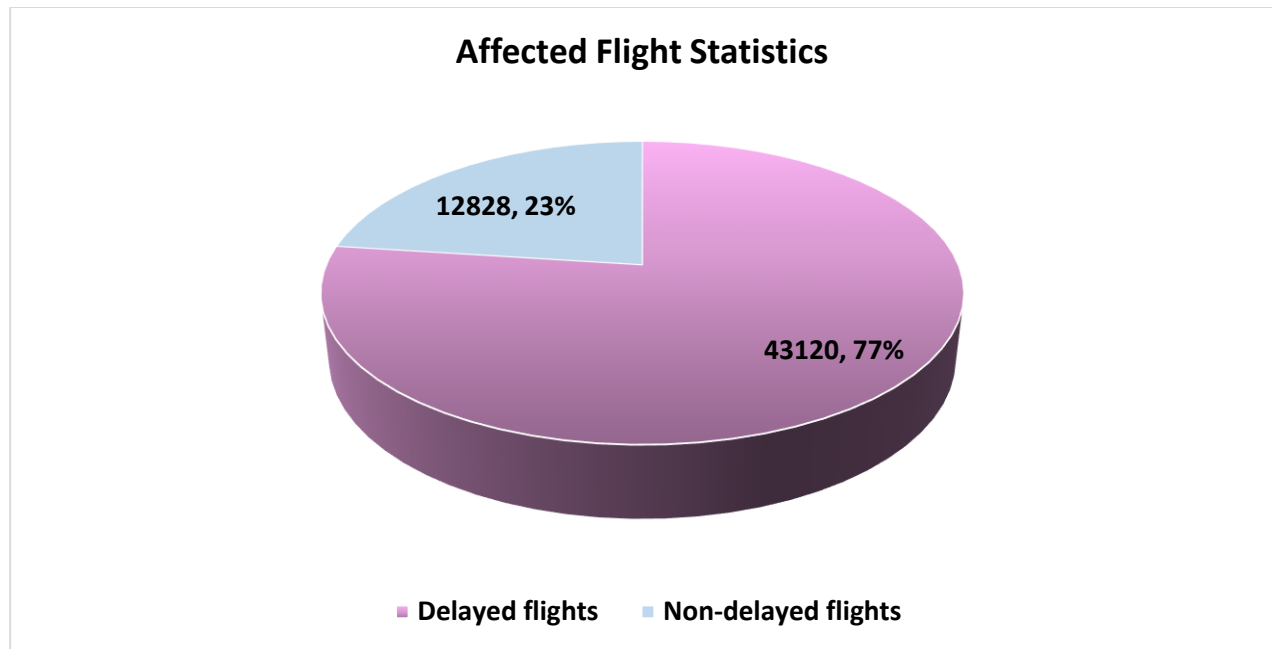


Figure 2 - Affected Flight Statistics

1.3 Inference

1. Out of the total arrivals captured to the constrained Airport during the CDM scenario (Figure-1), only 82.6% of flights i.e. Domestic arrivals are participating.
2. Out of these Domestic Arrivals, 77% of flights are given ATFM ground delay & 23% of flights are without any ATFM delay (Figure-2).
3. Out of the total arrivals in ATFM scenario, only 63.6% of flights (domestic Arrivals with ATFM delay) are affected by ATFM measures.

2. ATFM Ground Delay

Data analysis of this section provides insight into impact of ATFM measure i.e. Ground delay. The study of delay distribution will provide seriousness of capacity constraint.

2.1 ATFM Delay statistics

Total affected flights in scenario (Domestic Arrivals)	55948
Total ATFM Delay (CTOT-ETOT)	619692 minutes (10328hrs:12mins)
Average ATFM Delay for affected flights	11 minutes
Maximum ATFM Delay	152 minutes

Table-3

Note:

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

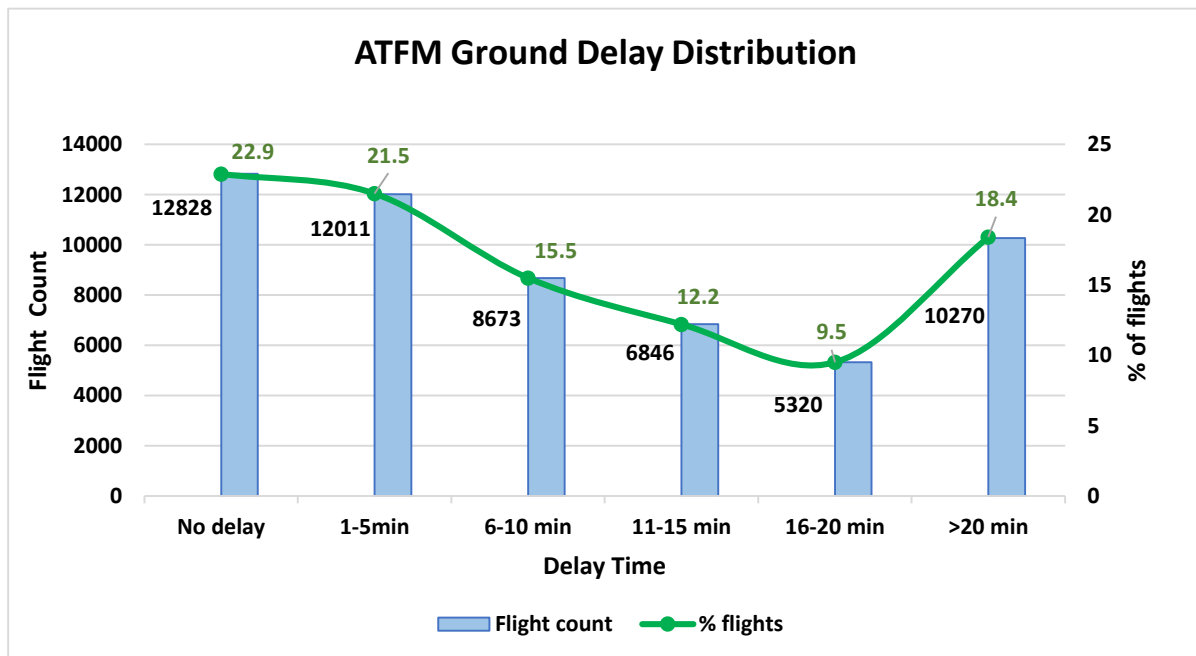


Figure 3 - ATFM Ground Delay Distribution

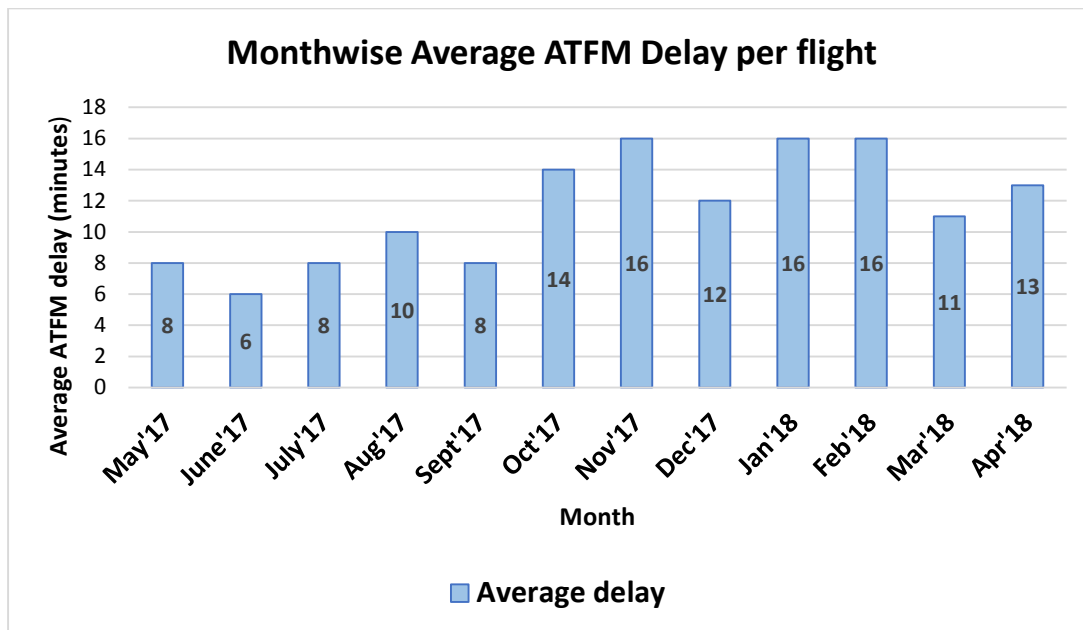


Figure 4 - Monthwise Average ATFM Delay per Flight

2.2 Inference

1. Among the total affected flights, 22.9% of flights, were not given any ATFM delay. (Figure-3)
2. Among the total affected flights, 37% of flights, were given ATFM delay up to 10 minutes. (Figure-3)
3. Among the total affected flights, 21.7% of flights were given ATFM delay in the range of 11 to 20 minutes. (Figure-3)
4. Among the total affected flights, 18.4% of flights were given ATFM delay of more than 20 minutes. (Figure-3)

3. ATFM Compliance Measurement

Data in this section helps to assess the actual situation achieved at the constrained airport.

Analysis provides:

- Overall picture of flights operating within compliance window.
- Overview of regulated flight departures within ATFM slot tolerance window (ASTW), before ASTW & after ASTW
- Compliance rate Airline Operator wise , Region wise, Station wise within different Regions and Reasons for Non-Compliance

3.1 Overall Compliance

Total Flights (Domestic arrivals)	55948
Flights with complete data (ATOT)	50129
Flights with incomplete data/ Flights Not Operated	5819
Compliant	32463
Non-Compliant	17666

Table-4

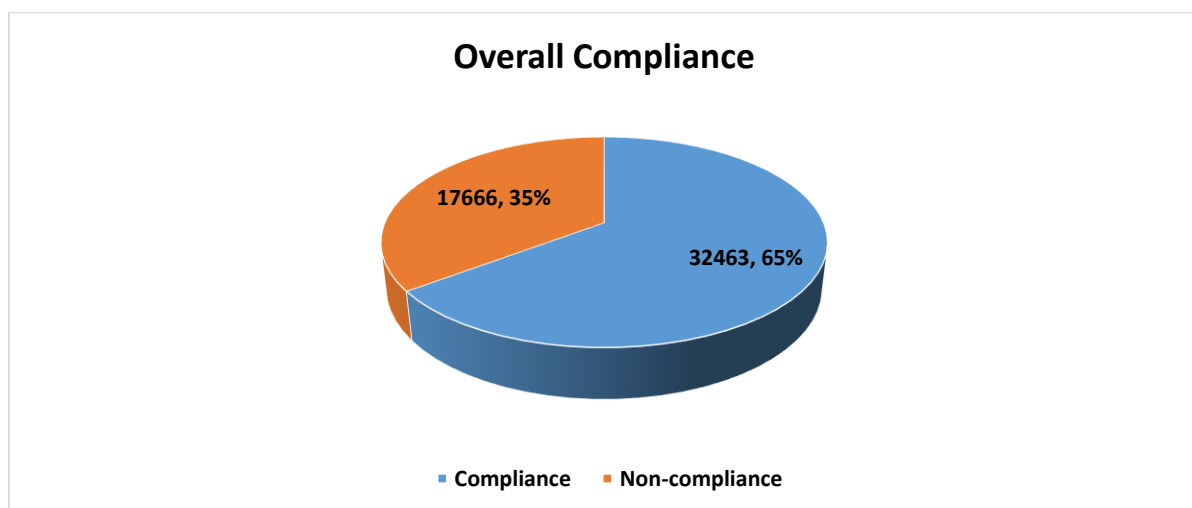


Figure 5 - Overall Compliance

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

3.2 ATFM Slot Adherence distribution

ATFM Slot tolerance window (ASTW) is -5 to + 10 minutes of CTOT. The aircraft departing within this window shall be considered adhering to ATFM slots i.e. compliant flights.

Flight departing before 5 minutes & after 10 minutes of CTOT shall be considered out of ATFM slot tolerance window & accordingly termed as Non-Compliant i.e. before / after ASTW departures respectively.

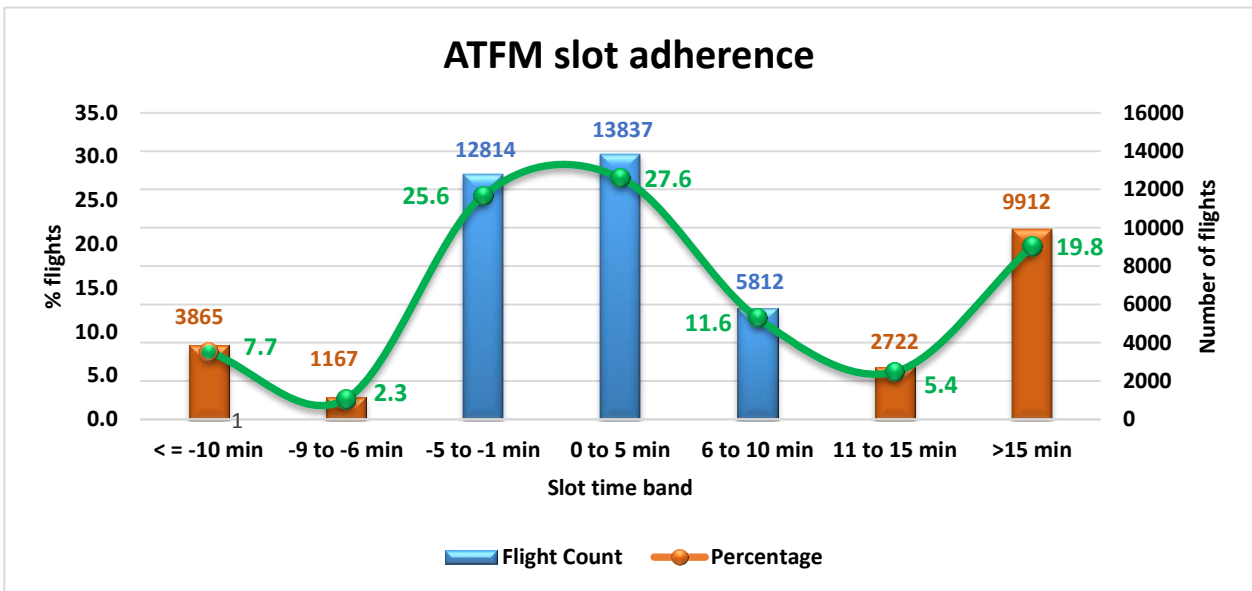


Figure 6 - ATFM Slot Adherence

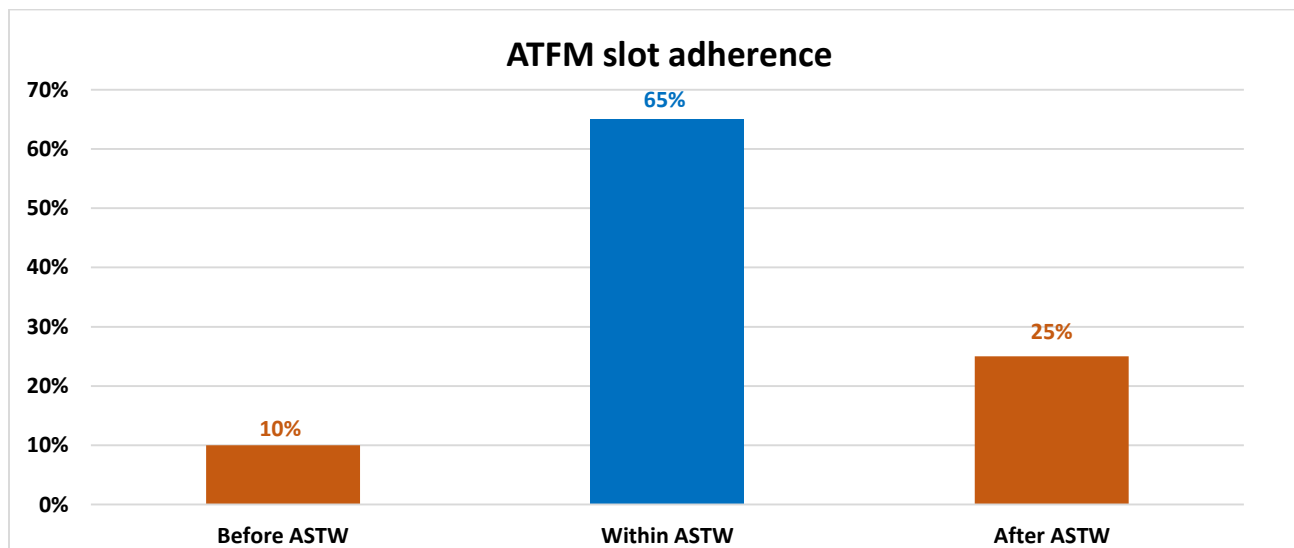


Figure 7 - ATFM Slot Adherence

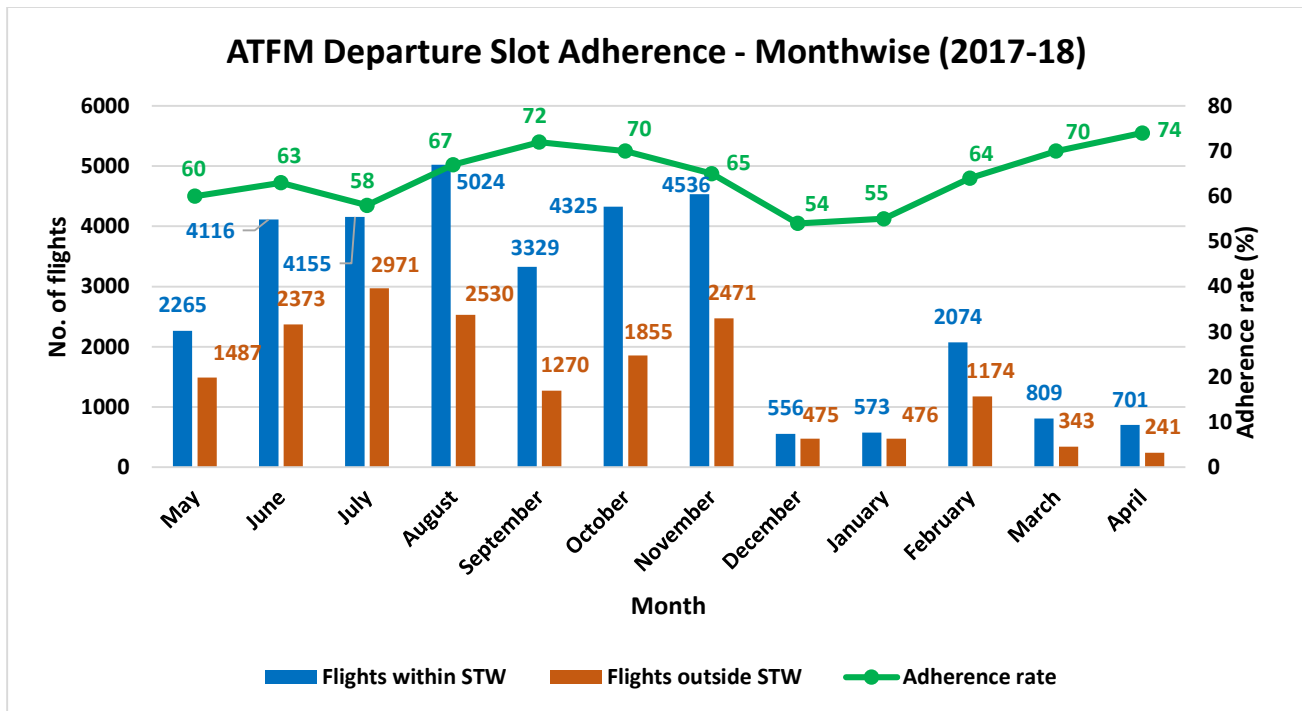


Figure 8 - ATFM Departure Slot Adherence - Monthwise (2017-18)

3.3 CTOT Adherence rate of Airline Operators

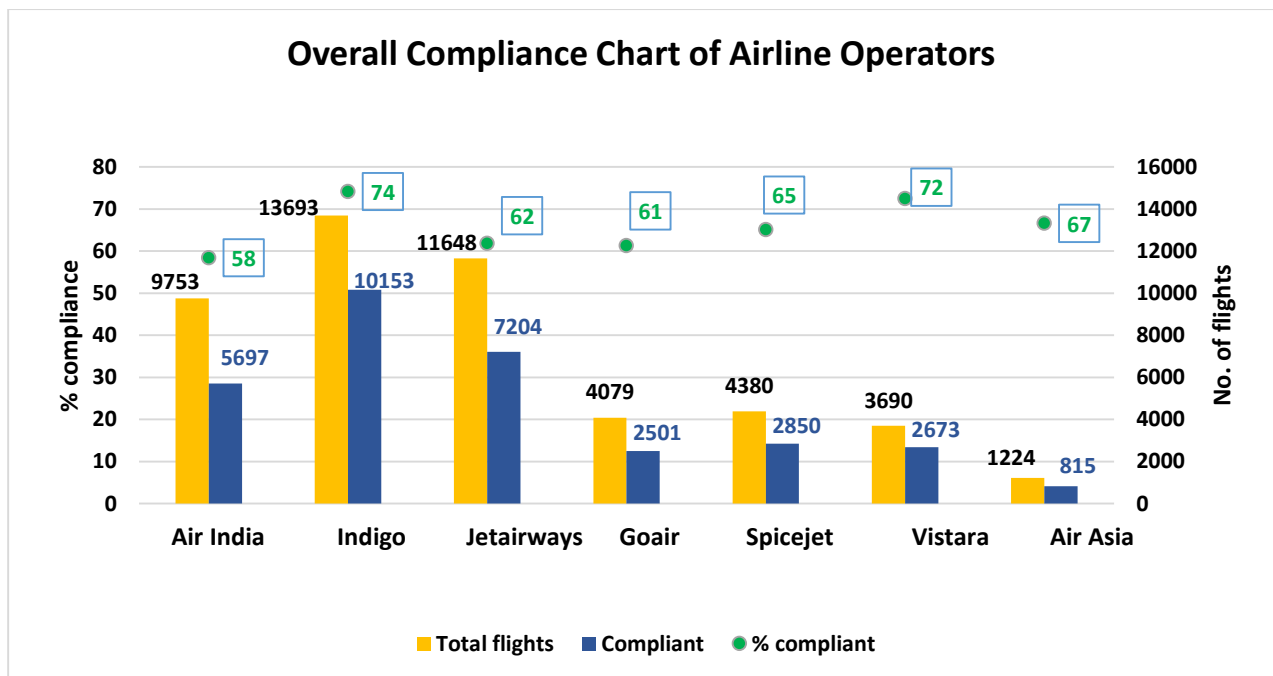
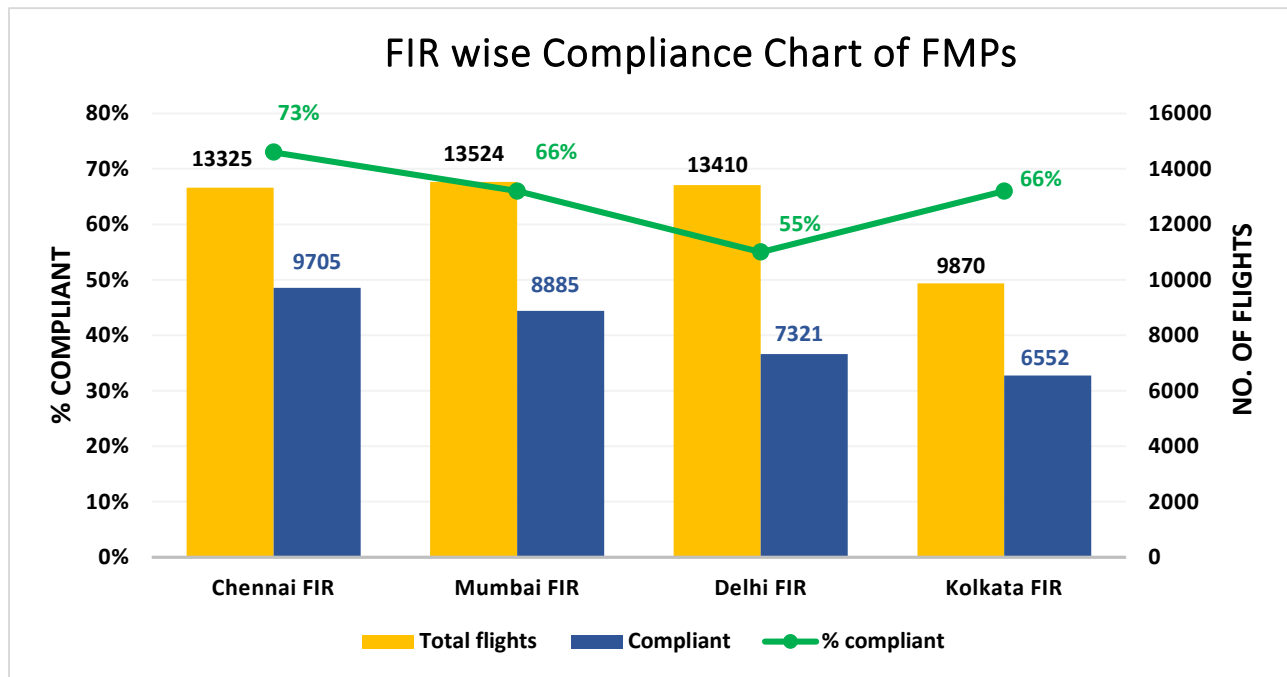


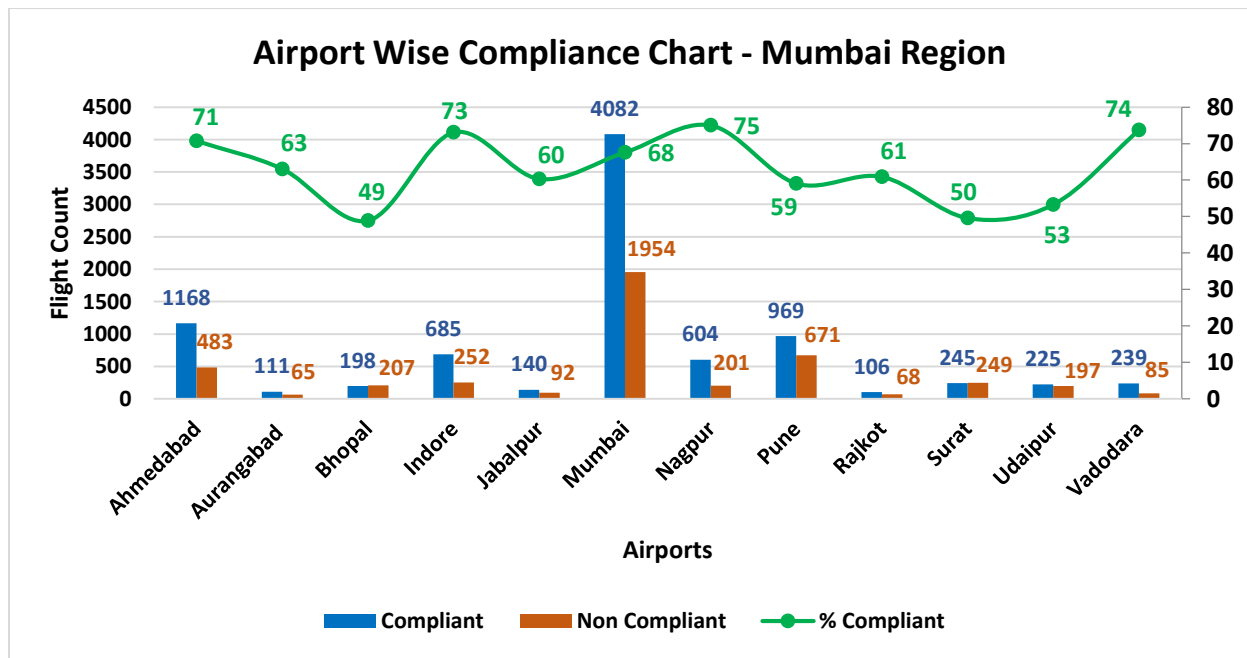
Figure 9 - Overall Compliance Chart of Airline Operators



3.4 CTOT Adherence rate by FMPs (Region wise)

**Figure 10 - FIR wise Compliance Chart of FMPs**

3.5 CTOT Adherence rate - Airport wise

**Figure 11- Airport Wise Compliance Chart - Mumbai Region**

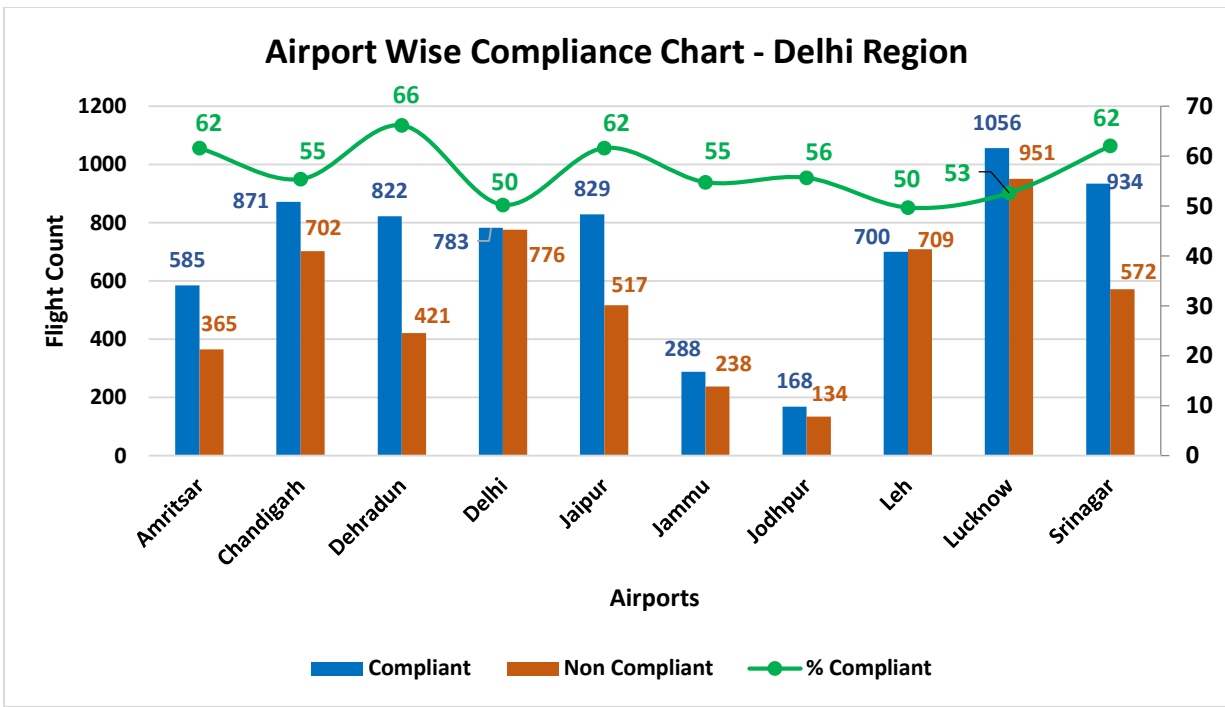


Figure 12 - Airport Wise Compliance Chart - Delhi Region

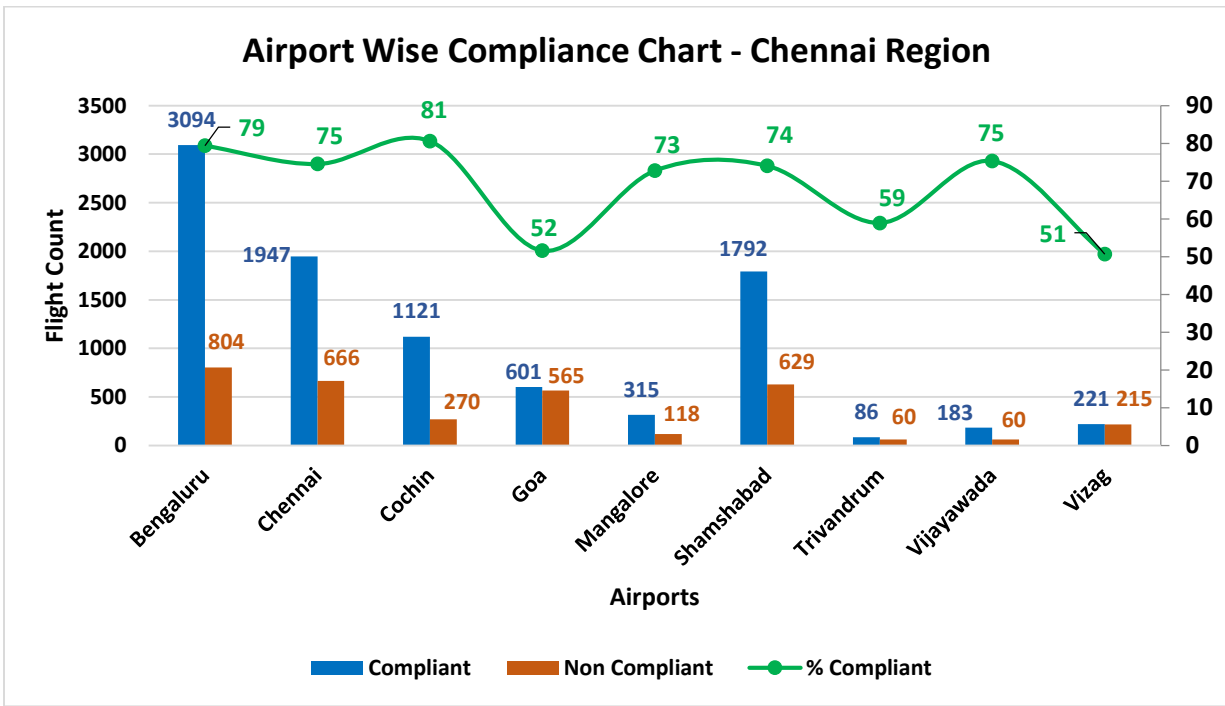


Figure 13 - Airport Wise Compliance Chart - Chennai Region

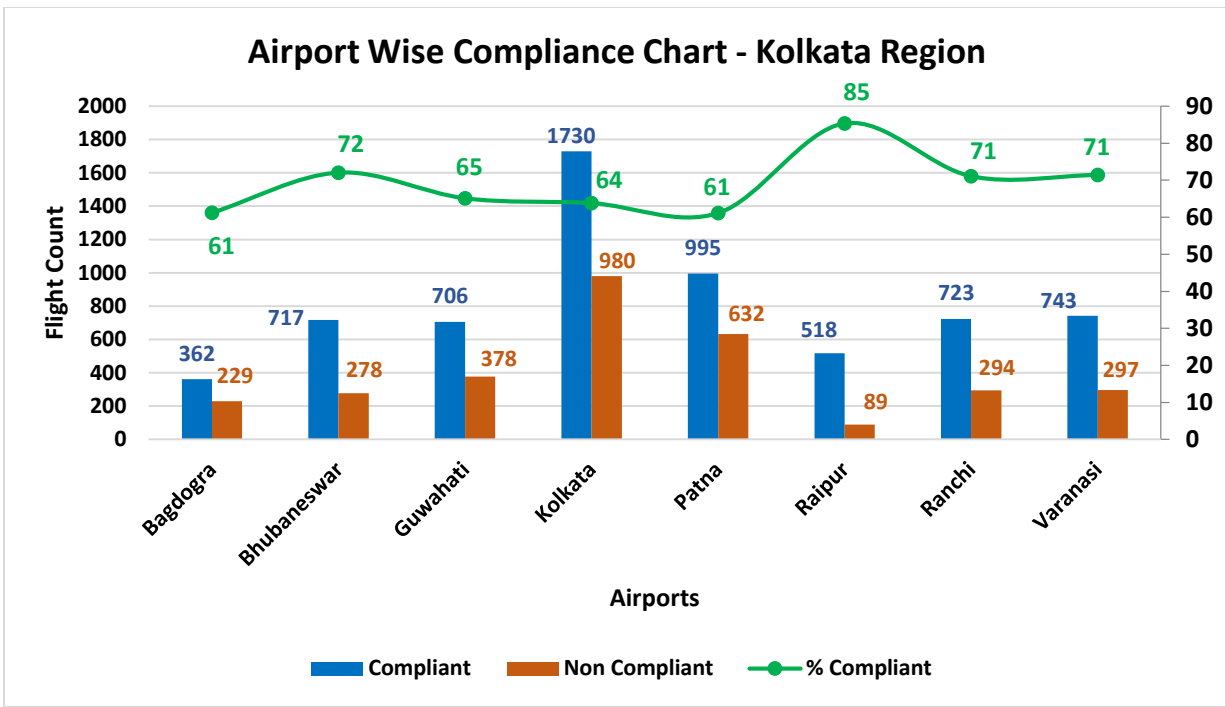


Figure 14 - Airport Wise Compliance Chart - Kolkata Region

3.6 Reason for Non-Compliance (Sample Study – Oct'17)

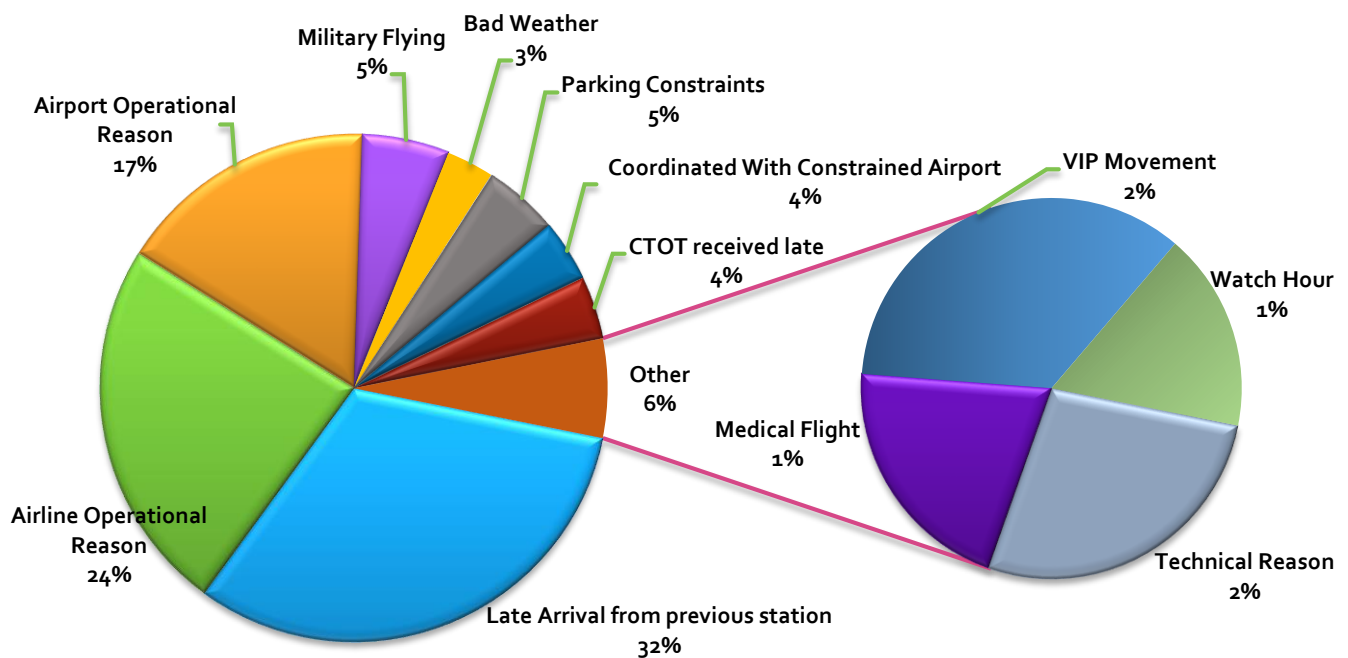


Figure 15 - Reason for Non-Compliance (Sample Study – Oct'17)



3.7 Inference

1. Out of the total domestic arrivals with complete data in ATFM scenario, 65% are compliant. (Figure-7)
2. Indigo, Vistara and Air Asia have a compliance rate of more than average recorded 65% compliance. (Figure-9)
3. Chennai region is having highest compliance rate of 73% whereas Delhi region is the lowest with compliance rate of 55%. (Figure-10)

4. Air Delay

Air delay can be computed by comparing flights' **Actual Elapse Time (AET)** against **Estimated Elapse Time (EET)**. EET can be obtained from flight plans or by calculating (CLDT – CTOT), whereas AET can be obtained from the difference between actual landing time (ALDT) and actual take-off time (AET = ALDT – ATOT).

Therefore, Air delay = AET-EET

This data provides effectiveness of ATFM program in facilitating traffic flow into the constrained airport (without excessive delay)

In most months of the report, EET was obtained by calculating CLDT-CTOT (SKYFLOW system), as it is cumbersome to extract EET from FPL of each flight. Since April 2018, EET is extracted from RPL/FPL.

Distribution of difference between AET & system EET

AET-EET min (time band)		<= -10	-9 to -6	-5 to -1	0 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30	>30
Compliant	Flt. count	447	714	2860	6989	5649	4969	3600	2521	1567	2741
	% flight	1.4	2.2	8.9	21.8	17.6	15.5	11.2	7.9	4.9	8.6
Non-compliant	Flt. count	736	412	1255	3395	2714	2509	1814	1388	896	1965
	% flight	4.3	2.4	7.3	19.9	15.9	14.7	10.6	8.1	5.2	11.6

Table-5

NOTE:

1. ATOTs have been taken from feedback received from FMPs.
2. ALDTs have been taken from Delhi automation data, Bengaluru AOCC and Mumbai Airport CDM

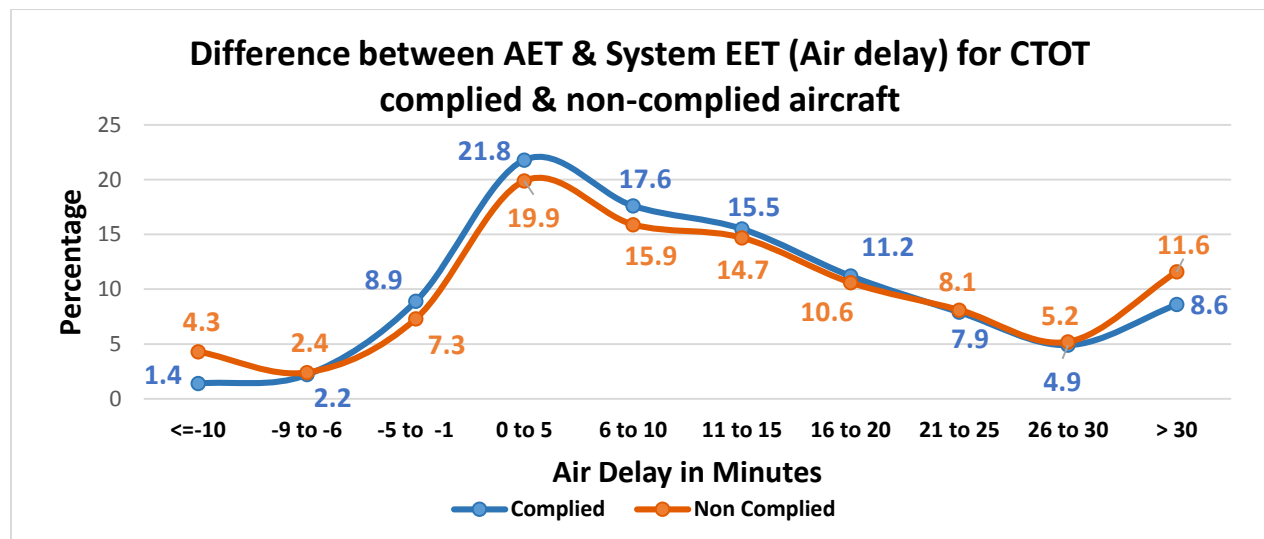


Figure 16 - Difference between AET & System EET (Air delay) for CTOT complied & non-complied aircraft

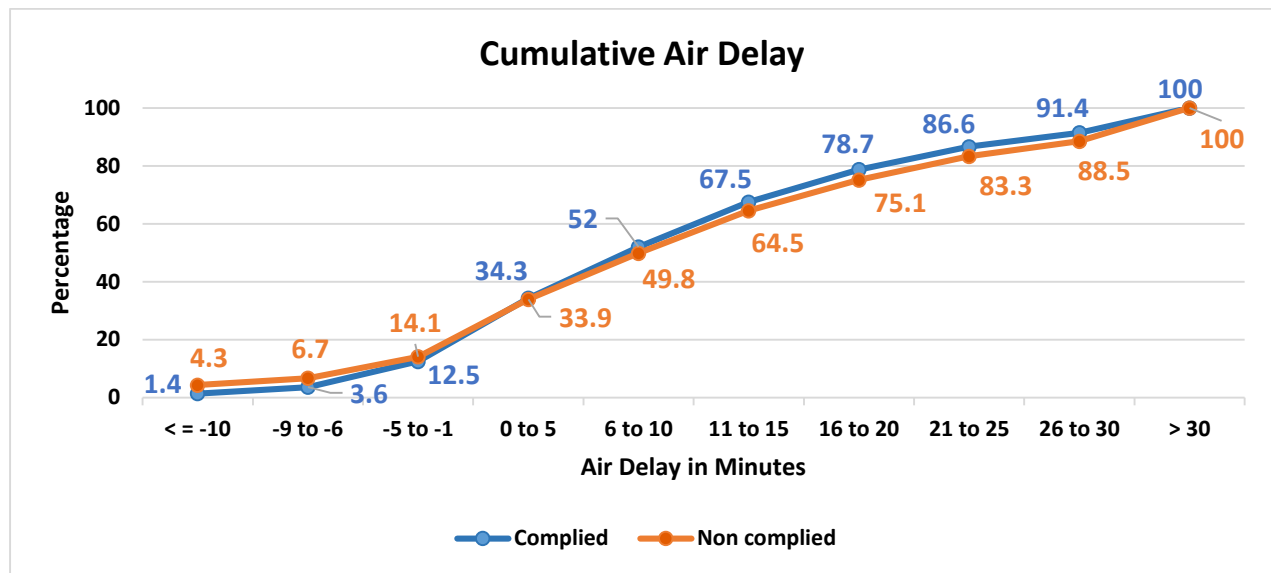


Figure 17 - Cumulative Air Delay

4.1 Inference

- 67.5% of compliant flights have AET, not more than 15 minutes, than system EET. (Figure-17)
- 64.5% of non-compliant flights have AET, not more than 15 minutes than system EET. (Figure-17)
- 32.5% of compliant flights faced delay of more than 15 minutes. (Figure-17)
- 35.5% of non-compliant flights faced delay more than 15 minutes. (Figure-17)

Above statistics shows that the air Delay for complied flights is moderately better than for non- complied flights. However, no categorical conclusion can be drawn from the above statistics.



5. System Challenges

1. “Watch Hours” of all the Airports is entered in the system. However, the system does not consider these watch hours while issuing CTOTs and issues CTOTs beyond the watch hours of the Airport.
2. “Partial Update” feature of updating the demand in tactical environment leads to large delays to a new FPL or any “CHG” message received for any FPL (irrespective of the change , e.g. an aircraft type, route, EOBT change etc. is likely to affect the profile of the aircraft, whereas a change in navigation capability, squawk change does not have any influence on the profile)
3. System creates different flight Profiles depending on filed FPL. For International flights the system reads the Estimated elapse time till our Indian FIR boundary for profile generation. In many cases the profile generated is not correct.
Profile calculated is different, for flights using ‘DCT’ in place of ATS routes, flights mentioning STARs in the route and flights mentioning STAR transition fix in the routes. The profile hence calculated for city pairs is differing by as much as 15 minutes for similar performance aircraft. The upper wind conditions are not considered in profile generation.

This reflects the flights at wrong timings as compared to their actual entry into the constrained Airport.

4. Departure and Arrival messages received through AFTN by ATS automation system are at times, rejected by the SKYFLOW system(due synchronization issue). In such cases, SKYFLOW system will not be able to update the flight plan information for the concerned flights. SKYFLOW is also capturing the wrong ATOT because of multiple departure messages received. (issue already raised to ATECH)
5. After using "APPLY" feature to a CDM scenario, Delay messages (DLA) are being sent by SKYFLOW system resulting in revision of EOBT of the delayed flight in ATS automation system .This is incorrect, as the initiation of a DLA message is the prerogative of the originator. The issue is already taken up with ATECH.
6. The system does not have any feature to put independently Airport Arrival rate (AAR) and Airport Departure rate (ADR) to regulate the demand against the practiced capacity.
7. Manual session created accepts new FPLs but the same is not reflected as a demand in Demand Chart and Time Table.
8. System functionalities are limited to balancing demand against capacity of an individual Aerodrome. **In case of two constrained Airports with overlapping timings, the SKYFLOW system Algorithm may not be able to give an acceptable solution. (refer ATECH e-mail dated 28th April, 2017).**



6. Operational Challenges

1. The existing means of CTOT dissemination by FMPs to different ATS units and ATCs within their jurisdiction leads to delays in timely dissemination of CTOTs for ensuring compliance. The Airline operators are also falling short in their responsibility of sharing the CTOTs received with their Air crew.
2. FMPs installed at Defence Airports have been trained on ATFM “SKYFLOW” but still have CTOT accessibility issues. Information sharing regarding commencement of ATFM measures and ADP is still an issue with these stations.
3. A lead in time of at least 3 hours is required for preparation of CDM, in order to disseminate CTOTs at least 2 hours prior to EOBT. Airports with flying time of more than 2 and half hours face the difficulty in dissemination of the CTOT information to Airlines in time for CTOT compliance. This leads to non-compliance of CTOT timings, as with passengers on board the flights, it becomes difficult for Airlines to comply with the CTOT restriction.
4. Due to lack of understanding at many Airports, flights following ATFM Ground delay for a constrained Airport are held on ground and made to depart within their CTOT tolerance window whereas flights which are actually planned to operate after the ATFM Scenario period to the same constrained Airport are not restricted at all.
5. Many operators are not filing the FPLs, three (03) hours prior to their EOBTs leading to wrong demand prediction.
6. The flights given exemption (accommodated in the CDM with no delay) on operational grounds are at times not following the allotted CTOT (which is same as filed EOBT plus default taxi time). It is essential for all stakeholders to note that these exempted flights are accorded priority over others but even these flights need to adhere to the issued CTOT, within the permissible tolerance window of minus 5 and plus 10 minutes.
7. Increasing number of exemption requests on various reasons like VIPs on board, FDTL, watch hour restrictions, Sunset restrictions, operational Constraints etc. leads to undue delays to other flights.
8. The RPLs received from Airlines on fortnightly basis does help CCC in strategic decision making. Very few domestic airlines share their “No ops” information or send an associated AFTN CNL or CHG message. As SKYFLOW utilizes, RPL for Demand projection, absence of correct information leads to wrong demand prediction.

In some cases, the EOBT filed in RPLs with CCC and FPL filed on the day does not match leading to long error queues.
9. The CDMs prepared to cater to demand capacity imbalance towards the end of a day usually reflects wrong demand as the Flight intentions are not timely updated by Airlines in the SKYFLOW i.e. by generating appropriate ATS messages through AFTN.



10. CTOT compliant flights are not receiving any preference over non-compliant flights while arriving at constrained airport, therefore getting substantial ground as well as airborne delay.
11. Genuine requests for revision of slot allocation are handled **manually** by CCC as there is no provision of revision of CTOT in SKYFLOW system after the use of " APPLY " feature. This is an important factor for determining over or under delivery of flights to a constrained Airport. **SKYFLOW system does not have facility of dynamic CTOT allocations. (refer ATECH e-mail dated 28th July, 2017)**
12. CDMs prepared to cater to post Weather disruption or post exigency period, even with few hours prior notice might not capture actual scenario, as for a correct demand prediction updated information on delayed and diverted flights in the SKYFLOW system is essential. Airport operators are also unable to provide advance flight information due to uncertainty in such situation.

----- X -----