International Civil Aviation Organization

The Sixth Meeting of ICAO Asia/Pacific Air Traffic Flow Management Steering Group (ATFM/SG/6)

Bangkok, Thailand, 06 – 10 June 2016

Agenda Item 6: Development of Regional ATFM Framework

REGIONAL ATFM IMPLEMENTATION GUIDANCE

(Presented by the Secretariat)

SUMMARY

This paper presents a draft version of the Asia/Pacific Regional ATFM Implementation Guidance document, developed by IATA.

1. INTRODUCTION

1.1 The 4th Meeting of the ATFM Steering Group (ATFM/SG/4, Bangkok, Thailand, 1 – 5 December) agreed to support Phase Two of the IATA Regional Air Traffic Flow Management Project that would inter alia develop a regional cross-border ATFM implementation plan.

2. DISCUSSION

2.1 ATFM/SG/4 agreed to the following Decision:

> ***ATFM/SG Decision 4/3: IATA Asia Pacific Regional Air Traffic Flow Management Project – Phase Two:***
>
> *The Asia Pacific Air Traffic Flow Management Steering Group agrees to support Phase Two of the IATA Regional Air Traffic Flow Management Project that will:*
>
> - *develop a regional cross-border ATFM implementation plan in harmonization with existing cross-border ATFM implementation projects for consideration by the ATFM Steering Group and States at ATFM/SG/5; and*
>
> - *develop in cooperation with ICAO a program to advocate for and educate stakeholder groups on cross border regional ATFM through a series of workshops partially funded by IATA (provision of SMEs) and logistically supported by States (e.g. venue provision).*

2.2 The IATA project has now developed a draft Regional ATFM Implementation Guidance document for consideration by the meeting. The guidance document has been edited by the ICAO Secretariat to ensure alignment to the maximum extent possible with the form and structure of other comparable ICAO APAC documents, including the Regional Framework for Collaborative ATFM.

2.3 The edited draft guidance document is provided for review and discussion by the meeting at **Attachment A**. The original draft document as provided by IATA is available on request.

2.4 The meeting is invited to review the draft guidance document, and then agree to the following Draft Conclusion:

Draft Conclusion ATFM/SG/6-X: Asia/Pacific Regional ATFM Implementation Guidance Material

That, regarding the Asia/Pacific Regional ATFM Implementation Guidance (**ATFM/SG/6/WP13/Attachment A**), ICAO be requested to:

a) Make the Guidance available on the ICAO Asia/Pacific Regional Office web site; and

b) Reference the Guidance document within the Asia/Pacific Regional Framework for Collaborative ATFM

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) review the Draft Asia/Pacific Regional ATFM Implementation Guidance;

c) agree to the proposed Draft Conclusion; and

d) discuss any relevant matters as appropriate.

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INTERNATIONAL CIVIL AVIATION ORGANIZATION

DRAFT

ASIA/PACIFIC REGIONAL

AIR TRAFFIC FLOW MANAGEMENT

IMPLEMENTATION GUIDANCE

Version 1.0 September 2016

This document was developed by the Asia/Pacific Air Traffic Flow Management Steering Group (ATFM/SG)

Approved by APANPIRG/27 and published by the

ICAO Asia and Pacific Office, Bangkok

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INTRODUCTION

Executive Summary

1.1 The large growth of air traffic movements in the Asia-Pacific (APAC) region in recent years has resulted in airport and airspace capacity that is inadequate to accommodate the ever increasing demand. The failure to balance demand and capacity has been exacerbated by airborne holding and excessive tactical Air Traffic Control (ATC) measures, which result in increased airline sector times. In addition, adverse weather often reduces the capacity of airports and airspace, resulting in additional strain on the air navigation service providers (ANSPs).

1.2 While it is a requirement under Annex 11 to the Convention on Civil Aviation for States to implement Air Traffic Flow Management (ATFM), the more urgent impetus to do so is that balancing the demand against capacity will create a more orderly and expeditious flow of traffic. There already have been many successful implementations of ATFM in other parts of the world; however, the APAC region has unique Cross-Border requirements which must be addressed through Regional and Sub-Regional ATFM planning and implementation. Positive progress has been made—with the involvement of all appropriate stakeholders—in defining the required Concept of Operations (ConOps) for the region. This development is ongoing and will evolve as the various initiatives mature.

1.3 The Asia/Pacific ATFM Steering Group (ATFM/SG) recommended that a *distributed multi-nodal ATFM network,* detailed in the *Asia/Pacific Regional ATFM Concept of Operations* ("the Regional ATFM ConOps") be adopted as a key concept of the *Asia/Pacific Regional Framework for Collaborative ATFM* ("the Regional ATFM Framework") Both the ConOps and the Framework were formally endorsed by the 26th Meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/26, Bangkok, Thailand, 7-10 September 2015. Cross-Border Multi-Nodal ATFM will ensure a network approach to ATFM on a regional and/or sub-regional basis. Trials of the Cross-Border Multi-Nodal ATFM concept are currently underway with positive results being achieved.

1.4 Capacity growth should always be a priority and have ongoing focus by ANSPs and airports. ANSPs should carry out analysis of their operations to establish if ATFM/CDM is required and if required, which concept as described in this document should be implemented. Should a State not have requirements for ATFM, they are expected to support other States that are implementing ATFM/CDM by adhering to agreed region procedures. Cooperation and collaboration between all stakeholders in the region will ensure successful implementation of ATFM/CDM in the region, which will benefit all users by reducing airborne holding, increasing predictability, and providing greater operational flexibility.

Scope and Purpose of the ATFM Implementation Guidance Document

2.1 The purpose of this document is to provide guidance to the ANSPs in the APAC Region on ATFM/CDM implementation strategies, with particular emphasis on Cross-Border Regional ATFM/CDM. In addition to this, the document will support the the Regional ATFM Framework to ensure synergies during implementation of ATFM in the region.

2.2 There is clear evidence that implementation of ATFM/CDM in other areas of the world has brought significant benefits to the aviation community. For ATFM/CDM to be effective in the APAC region, Regional ATFM procedures and Cross-Border operations will be required due to the unique operational requirements of the region.

2.3 ATFM/CDM implementation is a complex task and this document is not the definitive manual on implementation; however, it is intended to serve as a guide for Cross-Border Regional ATFM implementation for APAC and should be read in conjunction with other relevant documentation on ATFM implementation.

2.4 The International Civil Aviation Organisation (ICAO) Doc. 9971 – Manual on Collaborative ATFM, together with the Regional ATFM ConOps and the Regional ATFM Framework guide ANSPs in the planning and implementation of interoperable cross-border ATFM. Regional ATFM ConOps details the ATFM concept for the Region, and the Regional ATFM Framework details the "what and when" of implementation. This document, the Asia/Pacific Regional ATFM Implementation Guidance Document, provides additional guidance (the "how") for states in the APAC region and will assist ANSPs with both identifying and implementing the appropriate ATFM capability in their areas of responsibility. It is fully expected that this document will evolve as the Cross-Border Multi-Nodal ATFM concept further develops.

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LIST OF ACRONYMS

A-CDM ..... Airport Collaborative Decision Making

AATIP..... ASEAN Air Transport Integration Program

ACC ..... Area Control Centre

ADP ..... ATFM Daily Plan

AFIX ..... Arrival Fix

AFTN..... Aeronautical Fixed Telecommunications Network

AMAN ..... Arrival Management

ANSP ..... Air Navigation Service Provider

APAC..... (ICAO) Asia and Pacific Region

APANPIRG..... Asia/Pacific Air Navigation Planning and Implementation Regional Group

ASBU..... Aviation System Block Upgrades

ASEAN ..... Association of Southeast Asian Nations

ATC ..... Air Traffic Control

ATCC..... Air Traffic Control Centre

ATCO..... Air Traffic Controller

ATCSCC..... Air Traffic Control System Command Center

ATFM ..... Air Traffic Flow Management

ATFM/CDM ..... ATFM Collaborative Decision Making

ATFM/SG ..... ICAO Asia/Pacific Region ATFM Steering Group

ATM..... Air Traffic Management

ATS..... Air Traffic Service

AU..... Airspace Users

CAAS..... Civil Aviation Authority of Singapore

CANSO..... Civil Air Navigation Services Organisation

CBA ..... Cost Benefit Analysis

CDM ..... Collaborative Decision Making

CFMU ..... Central Flow Management Unit

CLDT ..... Calculated Landing Time

CNS..... Communication, Navigation, and Surveillance

CO_2..... Carbon Dioxide

ConOps ..... Concept of Operations

CTO ..... Controlled Time Over

CTOT ..... Calculated Take-off Time

DCB ..... Demand and Capacity Balancing

DMAN ..... Departure Management

ECAC..... European Civil Aviation Conference

EU ..... European Union

FAA ..... Federal Aviation Administration

FDP ..... Flight Data Processor

FIR ..... Flight Information Region

FIXM ..... Flight Information Exchange Model

FMP ..... Flow Management Position

FMU..... Flow Management Unit

FOC..... Flight Operation Centre

FPL..... Flight Plan Message

GDP ..... Gross Domestic Product

GDP ..... Ground Delay Program

HITL ..... Human-In-The-Loop

IATA..... International Air Transport Association

ICAO..... International Civil Aviation Organisation

ILS ..... Instrument Landing System

LOA ..... Letter of Agreement

MINIT ..... Minutes in Trail

MIT ..... Miles in Trail

NARAHG ..... North Asia Regional ATFM Harmonisation Group

NAS ..... National Airspace System

NavAid..... Navigation Aid

NOPS ..... Network Operations

PBN..... Performance-Based Navigation

RFIX ..... En-route Fix

SG ..... Steering Group

SME ..... Subject Matter Expert

US/U.S. ..... United States of America

VIP ..... Very Important Person

WATS ..... World Air Transport Statistics

WSG..... World Slot Guidelines

BACKGROUND OF ATFM/CDM IN THE ASIA/PACIFIC REGION

Introduction

1.1 In 2014, after identifying the need to have regional Air Traffic Flow Management (ATFM) in the region, the International Air Transport Association (IATA) initiated a project to establish a regional baseline of ATFM capability with particular reference to Cross-Border ATFM/ Collaborative Decision Making (ATFM/CDM) capabilities. The project, endorsed by the ATFM/SG, conducted a region wide survey of Air Navigation Service Providers (ANSPs) to establish the regional base-line of ATFM capability. The results showed that while all ANSPs in the Asia-Pacific (APAC) region have implemented or have plans to implement ATFM/CDM, little collaboration in regard to Cross-Border ATFM/CDM is evident. As a result, the ATFM/SG endorsed a second stage of the project to develop an Implementation Guidance for Cross-Border ATFM/CDM for the APAC region.

1.2 It was recognised that a centralised ATFM concept, as practised in other parts of the world, is not feasible in the APAC region. For ATFM/CDM to be fully effective in the region, a scalable, collaborative, cohesive, and flexible approach for achieving integrated and coordinated ATFM capabilities within the APAC region will need to be adopted. As a result of this and recommendations from Phase 1 of the IATA project, the Asia/Pacific ATFM/SG accepted and endorsed the Multi-Nodal ATFM concept as the regional foundation for Cross-Border ATFM.

History of ATFM/CDM Implementation

1.3 The 1990s saw air traffic increases previously unseen in the U.S., bringing with it unprecedented delays. There were few tools available for CDM and fewer still for common situational awareness. The Federal Aviation Administration (FAA) found their already limited resources extremely strained. Air traffic controllers (ATCOs) had limited and untimely access to delay information around the National Airspace System (NAS) and were unable to adequately manage ground operations for congested or weather-impacted airports and airspace. Moreover, with a decentralised database of aircraft route data, there were no systems to identify problems or areas of inefficiencies throughout the NAS. Officials at the FAA sought procedures and systems that would aid in information-sharing and through . industry partnerships developed tools to assist them in predicting demand and consequently balancing demand against capacity. History has shown that these initiatives have enhanced safety and saved many tons of fuel over time.

1.4 In Europe the Central Flow Management Unit (CFMU) was created in 1995 as a response to the chronic delays plaguing European air traffic throughout the eighties. Based on ICAO's concept of centrally coordinated ATFM, and with the support of the European Civil Aviation Conference (ECAC) Member States, the CFMU succeeded in containing the delay crisis at the time. As a result, strong operational collaboration processes were put in place between all aviation actors—especially ANSPs and airlines—to manage traffic and delays in partnership.

1.5 ICAO has recognised that it is necessary for all ANSPs to have a common understanding of ATFM/CDM. To that end, ICAO published the following definition: "*A service established with the objective of contributing to a safe, orderly, and expeditious flow of air traffic by ensuring that Air Traffic Control (ATC) capacity is utilised to the maximum extent possible, and that the traffic volume is compatible with the capacities declared by the appropriate Air Traffic Services (ATS) authority.*"

1.6 Additionally, ICAO has published *ICAO Doc 9971- Manual on Collaborative ATFM Part 1 and 2* developed by Subject Matter Experts (SMEs) in ATFM/CDM from across the globe. Stakeholders are encouraged to read *ICAO Doc 9971* in conjunction with this APAC ATFM Implementation Guidance document.

1.7 To improve efficiency and optimise operations in the APAC region, APANPIRG/24 in June 2013 endorsed the *Asia Pacific Seamless Air Traffic Management (ATM) Plan*. The objective of the Seamless ATM Plan is to facilitate Asia/Pacific Seamless ATM operations by developing and deploying ATM solutions capable of ensuring the safety and efficiency of air transport throughout the APAC region. The Plan provides a framework for a transition to a Seamless ATM environment by establishing an expectation of harmonised and interoperable systems in order to meet future performance requirements. Aviation System Block Upgrade (ASBU) B0-NOPS *Network Operations* (of which ATFM taking a Network view is a key element) is a critical part of the plan and is also one of APANPIRG's top ten regional priorities.

APAC Regional ATFM/CDM Implementations and Strategies

1.8 In 2014, the study commissioned by IATA established a baseline view of ATFM capability and interoperability of States in the APAC region. It is important to list the key findings here as this implementation Guidance will address the shortcomings identified by the study.

1.9 The results of the study are summarised below (status in some countries may have changed since the study was completed):

- All APAC States have recognised the requirement for ATFM.
- Few States have well-established ATFM Organisational structures.
- ATFM infrastructure is very diverse; only two States, Australia and Japan have mature ATFM systems, while others have varying degrees of infrastructure, as indicated by the corresponding colours in the map and legend. See (**Figure 1**).
- CDM between States is minimal. While there is a common desire for better CDM, there is no standard for the region. (**Figure 2**).
- There is no substantive interoperability between the States. There is little official ATFM procedure agreement between States as written in the Letters of Agreement (LOAs). See (**Figure 3**).

- Airport capacities are declared for most major airports in the region, but only five States are declaring capacities for airspace.

- Very few countries are performing Demand Capacity Balancing (DCB) in the strategic phase of ATFM beyond allocating Airport Slots via the IATA World Slot Guidelines (WSG).

- Only the limited number of States with mature ATFM systems are able to carry out DCB in the pre-tactical phase.

- States without mature ATFM systems that are encountering DCB issues do not have any facility to monitor demand against capacity.

- Only five States (Australia, New Zealand, Philippines, China, and Japan) have the ability to issue ATFM Measures using allocated slot times to smooth traffic into airports.

- The major development in Cross-Border ATFM implementation is the Civil Aviation Authority of Singapore (CAAS)-initiated Regional ATFM ConOps. ANSPs and relevant stakeholders from four States participated in the development of the concept. The resultant collaborative trial of the concept—Distributed Multi-Nodal ATFM Operational Trial—is underway with the following nine States participating: Australia, China, Hong Kong China, Indonesia, Malaysia, Singapore, Thailand, Philippines, and Vietnam.

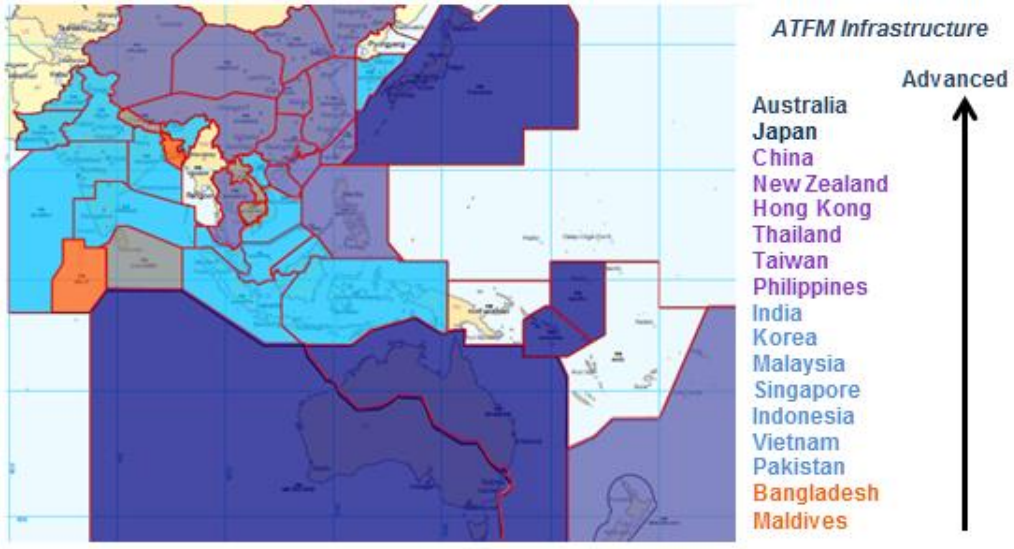


Figure 1: ATFM Infrastructure

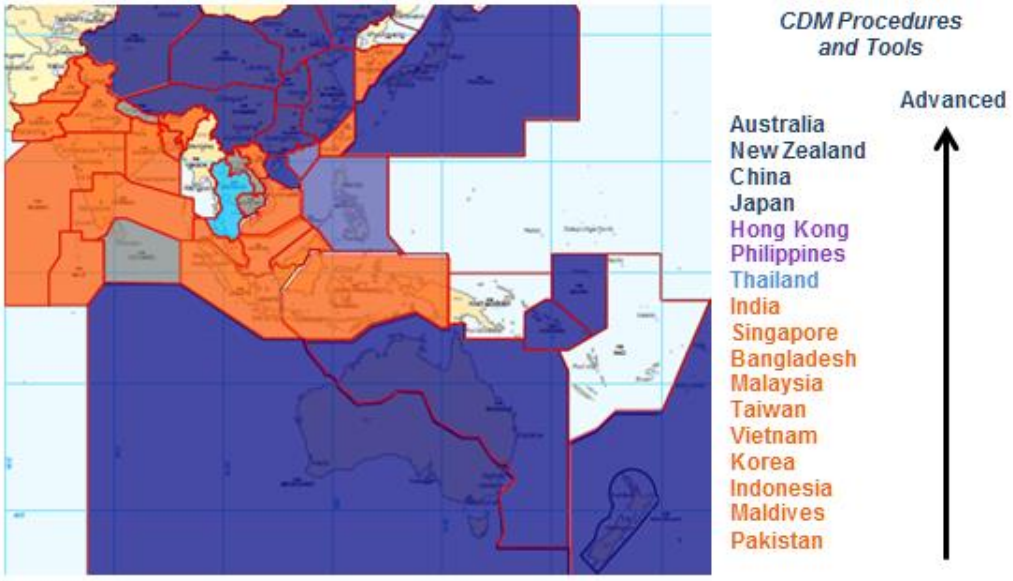


Figure 2: CDM tools and procedures between States

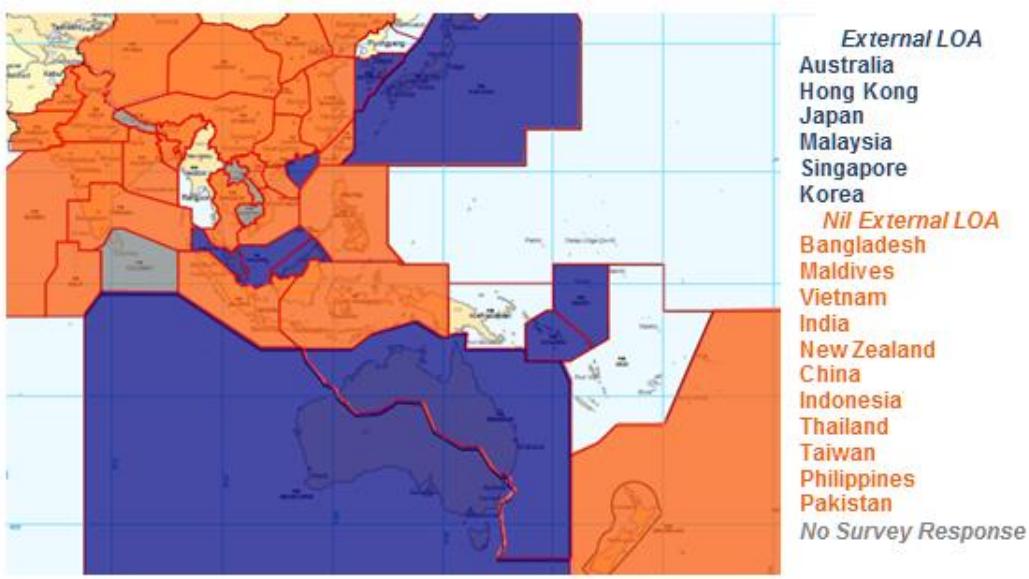


Figure 3: External LOA between States

1.10 The overarching finding of the study was that while all the surveyed ANSPs had ATFM/CDM implementation plans, there were no current Cross-Border arrangements to facilitate ATFM/CDM. There are initiatives to commence with Cross-Border ATFM which are discussed in following sections

ATFM/CDM in APAC and the Requirement for Cross-Border Regional ATFM/CDM

1.11 The APAC Region has experienced strong growth of 5–6% per year and is forecasted to continue this trend for the foreseeable future. Most regional hubs are already operating near the limits of their current capacity, and solutions to efficiently manage traffic flows are carried out to a large degree in isolation by individual ANSPs. During 2012, a Civil Air Navigation Services Organisation (CANSO) initiative led to Singapore, Hong Kong China, and Thailand commencing CDM trials. These trials showed that with the cooperation of ANSPs in the region, ATFM could be implemented; however, the existing centralised model of ATFM operations as in the Americas, Australia, South Africa and Europe was considered not suitable for the APAC region.

1.12 The traditional model of ATFM initiatives, which relies on delaying domestic traffic to achieve effective demand metering is not possible for a number of APAC ANSPs due to the lack of domestic traffic. During the development of the Regional ATFM ConOps it was determined that a 70% participation of flights is needed for ATFM measures[1] to be effective. Additionally, the makeup of the region, particularly South-East Asia, with relatively small Flight Information Regions (FIRs) require a Cross-Border solution..

Understanding the impact of ATFM/CDM implementation

1.13 ATFM is now entrenched in the ICAO ATM operational concept, the ICAO Aviation System Block Upgrade - Block 0 and Block 1 (ASBU B0/B1) and the Asia Pacific Seamless ATM Plan. Some ANSPs in the region, such as Japan, Australia, and New Zealand, have implemented ATFM/CDM these implementations have had significant positive impact on operations resulting in both qualitative and quantitative benefits.

1.14 For ATFM to have a sustained impact, the cooperation of the majority of stakeholders is required. Stakeholders' participation in ATFM includes activities such as ANSPs being required to respect ATFM measures applied in other Flight Information Regions (FIRs) that will affect operations in their own areas of responsibility, Aircraft Operators having to manage assigned delay by either taking ground delay or providing en-route delay intent to comply with delays imposed, and Airport Operators accommodating flights being delayed at departure airports. While ATFM requires the various user groups to actively participate in ATFM measures, the additional workload ultimately provides network benefits. Estimated benefits are discussed in later sections

1.15 When increased ATFM measures are introduced in the APAC region, whether domestically or Cross-Border, stakeholder education, interaction and consultation are necessary to ensure impacts, goals and overall network benefits are well identified and understood.

[1] ICAO Doc 9971 – *Manual on Collaborative Air Traffic Flow Management (Chapter 6)* defines ATFM Measures as *techniques used to manage air traffic demand according to system capacity. Some ATFM measures must be considered as control instructions or procedures.*

1.16 ATFM/CDM implementation will require new or changed working procedures, and a good understanding and application of these procedures will be required by all stakeholders for ATFM/CDM to be successful. It is essential that a collaborative approach is taken when agreeing new work practices and ensuring comprehensive communications and training is delivered to all stakeholders.

Cultural change

1.17 ATFM/CDM implementation requires a significant culture change in all stakeholder organisations. This culture change is required at all levels within organisations. In previous ATFM/CDM implementations, when a culture change was embraced at executive and senior management levels, the change has been effective. A change management process needs to be executed to ensure the culture change occurs. In particular, operational staff (ATCOs and pilots) are often reluctant to accept the change to a structured ATFM environment. It is essential that these groups are fully engaged and supportive of ATFM and special attention should be given to their training and education. This aspect of implementation should not be under-estimated and can be managed by education and effective change-management programs.

Benefits of ATFM/CDM implementation

1.18 The following are possible benefits derived as a result of ATFM/CDM implementation, whether Domestic or Cross-Border Regional ATFM. There are very clear advantages to the network if ATFM/CDM is conducted in accordance with a Cross-Border ConOps.

Qualitative benefits

- More timely and informed collaborative decision making which takes the entire region's requirements into consideration.
- A coordinated network ATFM approach to all air traffic flying in the region would result in a seamless, optimised, expeditious flow of traffic throughout the region.
- With the implementation of ATFM, automated and procedural communication will be implemented, benefiting not only ATFM communication, but also ATC communications.
- As ATFM develops in the region, States will be incentivised to collaborate on airspace design so as to accommodate better flows of traffic to accommodate ATM and ATFM procedures.
- Enhanced situational awareness for the region through shared information.
- As Regional ATFM matures, better planning and CDM in all phases of ATFM, including post-event analysis will occur.
- The traditional model of ATFM implementation requires only domestic traffic to adhere to the controlled times issued. The *Regional ATFM* ConOps requires all aircraft to adhere to assigned delays. Therefore, States with no domestic flights, such as Hong Kong China and Singapore, can perform demand and capacity balancing.

- In addition, if only domestic traffic is subject to ATFM measures, those aircraft can be unfairly delayed while non-participating aircraft (i.e., international flights) are not. With the Regional ATFM Concept, all traffic is expected to be subject to ATFM measures, and the delay is distributed fairly and equitably.
- Establishment of Regional ATFM will lead to enhanced information-sharing and CDM practises during events such as volcanic eruptions (as the FAA Air Traffic Control System Command Center [ATCSCC] and the EUROCONTROL Network Manager have collaborated during recent volcanic eruptions), disease, political unrest, and war.

Quantitative benefits

1.19 The aviation industry contributes significantly to State economies. In the Asia-Pacific region, the air transport sector supported 4.8 million jobs (2012) and contributed US$265 billion to the Gross Domestic Product (GDP). Oxford Economics forecasts the number of jobs supported by aviation and tourism impacts will increase by 91% by 2032.[2]

1.20 Successful Regional ATFM will optimise traffic flows by balancing demand with the available system capacity. This is achieved through the implementation of flow management measures based on an accurate prediction and assessment of demand and capacity. These flow management measures transfer existing delay to a more efficient phase of operation. Efficiency encompasses many variables but typically focuses on fuel burn savings, which are impacted by aircraft type, configuration, weight, altitude, etc. While the goal is the elimination of airborne delay, the benefit of transferring delay from the arrival phase (holding, speed control, vectoring) to ground delay for air carrier operations has resulted in an average savings of US$47 per minute in 2014. The Regional ATFM operational concept provides an additional mechanism to transfer assigned delay from the terminal area phase to the en-route phase of flight. It is estimated the benefit gained by absorbing some assigned delay more efficiently is projected to yield an average savings of US$42 per minute. Table 1 shows the possible quantitative benefits resulting from ATFM in the region.

2 ATFM	2014	2019
Regional ATFM	US$250 – $300M	US$600M – $800M
Domestic & Regional ATFM	US$660 – $810M	US$1.1B – $1.4B

Table 1. Possible quantitative benefits of Regional ATFM

1.21 A complete list of benefits can be found in **0**.

[2] Aviation Benefits Beyond Borders, Air transport Action Group, April 2014.

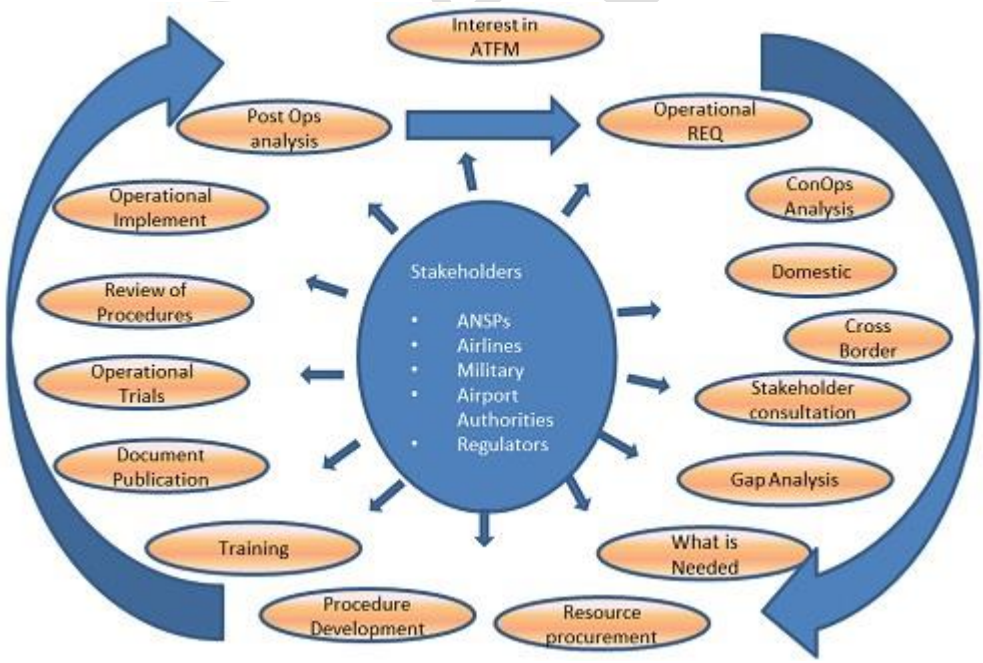
SETTING UP AN ATFM/CDM PROJECT

Requirement assessment and gap analysis assessment

2.1 ANSPs should perform an analysis of ATM operations to determine whether ATFM is required in their environment and if so, the scope of ATFM implementation, capacity enhancement initiatives must be considered in conjunction with any assessment of the requirement for ATFM. The operational requirements assessment should determine the scope of ATFM implementation; either Domestic ATFM or Cross-Border ATFM as detailed in the Regional ATFM Framework. This assessment can be carried out internally or by an external experienced agency. Once the scope of ATFM is identified, a gap analysis needs to be carried out to identify the existing baseline, technical capabilities, and implementation requirements for the State concerned.

General ATFM/CDM implementation process

2.2 A general process for ATFM/CDM implementation is presented in Figure Figure **4**. It shows the implementation process of ATFM/CDM, whether it be Domestic or Cross-Border Regional ATFM/CDM. The process commences with an interest in implementing ATFM/CDM from the Strategic phase to Post-Operational analysis with the entire process being regularly re-evaluated as requirements change. During the entire process there is continued stakeholder participation. A Cost Benefit Analysis (CBA) is not indicated; however, it should be performed.



Figure

Figure 4: Typical ATFM/CDM process

Educating and convincing all stakeholders

2.3 Most stakeholders will realise the value and benefits of ATFM/CDM implementation; however, previous implementations have shown that some stakeholders require education and to be convinced of benefits before completely accepting and becoming part of the implementation process. Programs need to be developed to educate all levels in stakeholder organisations, from operational staff to executive management. These programs could include workshops, seminars, etc. Printed and electronic media is also a valuable vehicle in educating stakeholders.

2.4 Experience shows it is imperative to get executive and senior management support. It is important to identify the correct stakeholders from the beginning of ATFM/CDM implementation and include them from the outset of ATFM/CDM implementation. Stakeholders may include but may not be restricted to the following:

1. Flow Management Units (FMUs);
2. Aircraft Operators – airlines, military, police, business aviation and general aviation;
3. Pilots;
4. Air Traffic Control (ATC) units
5. Airport authorities;
6. Adjoining ANSPs; and
7. Regulatory bodies.

Role of stakeholders

2.5 Stakeholders have distinct roles in ATFM /CDM. The following sections provide a high-level (i.e., non-exhaustive) description of their roles.

FMUs

- Daily Airport and Airspace Capacity determination
  - Demand Prediction – Flight progress is via manual input or automated data feed (e.g., ATM Automation System Flight Data Processor [FDP] or Aeronautical Fixed Telecommunications Network [AFTN])
- Capacity Management – Inputs from Flow Management Position (FMP) and Flight Operation Centre [FOC] are via ATFM web-based interface
- Assess effects of imbalance to traffic beyond capacity impact range
- Stakeholder CDM engagement

- Model Flow programs and set hourly capacity and arrival slots to ensure demand/capacity balance
- Slot assignments can be viewed via software web interface and notifications.
- Monitor effectiveness of ATFM measure and amend as required
- Provide daily post-operational analysis

Aircraft Operators

- Participate in CDM process (Telecons)
- Supplying flight updates via ATS methods or through CDM processes
- Monitor flight progress for compliance
- Manage flight delay intent and substitute flights if necessary

Pilots

- Follow ATC operational procedures when trying to achieve compliance by meeting intended delay absorption
- Communicate potential non-compliance

ATC

- Departure Airports – Monitor compliance with Calculated Take-Off Times (CTOTs)
- En-route – Aware of ATFM Measures but minimal interventions required
- Arrival phase of flight – Assist with compliance with Calculated Time Over Fix

Airport Operators

- Departure Airports – Respect ATFM-measure-affected departures and assist in meeting departure times based on Airport capacity
- Declare daily maximum allowable delay at gates

Adjoining ANSPs

- Reach agreement on Cross-Border operational procedures
- Write and sign LOAs – (Specific ATFM LOA Templates should be developed)

Regulators

- Coordinate with appropriate government body to ensure legislation supporting ICAO Document Annex 11 (Section 3.7.5, a and b) "develop and publish regulations applicable to all ATFM/CDM stakeholders, responding to this legislation."
- Ensure publication of ATFM procedures and information in the State Aeronautical Information Publication

Setting the objectives for ATFM/CDM Implementation

2.6 All ATFM/CDM partners have the common objective of providing a safe expeditious flow of traffic to Airspace Users to ultimately benefit passengers and cargo movement. To achieve this main objective, there are many supporting objectives such as:

- Enhance Safety
- Reduce fuel burn
- Reduce carbon emissions
- Increase situational awareness
- Improve predictability
- Optimise airspace and airport operations

2.7 In addition to the aforementioned objectives, Cross-Border Regional ATFM objectives include:

- Enable ATFM/CDM to be effectively implemented in States where there is insufficient domestic traffic
- Enable and apply ATFM measures to regional flights and across multiple FIRs
- Implement seamless ATFM across multiple FIRs

IMPLEMENTATION

Introduction

3.1 The ATFM baseline study indicated that all regional ANSPs, in accordance with ICAO requirements, have intentions of implementing ATFM; these initiatives vary from existing tactical ATFM measures to advanced strategic, pre-tactical, and tactical automated systems.

When should ATFM be implemented

3.2 ANSPs should have a plan for implementing ATFM, either domestically or regionally, depending on their requirement and level of maturity. Even though ANSPs may not have the operational requirement to implement ATFM domestically, they may be expected to participate in Cross-Border Regional Multi-Nodal ATFM by adhering to regionally accepted procedures, for example, ensuring that all flights subject to an ATFM measure comply with CTOT.

3.3 During the requirements analysis (detailed in section 3.3) ANSPs should ascertain when and in what form ATFM is required, and what trigger points need to be identified for implementation. For example, the trigger points could include when certain demand levels are reached which would allow the required lead time to implement the appropriate ATFM processes.

3.4 The level of an ATFM service required in each ANSP will depend on a number of factors as previously described. It is important to note that an ATFM service may be simple or complex depending on the requirements in an individual ANSPs area of responsibility. For successful implementation in the region it is important that all ATFM implementations are harmonized.

ATFM/CDM Requirements Analysis

3.5 ANSPs should perform an analysis of ATM operations to determine whether ATFM is required in their environment and if so, the scope of ATFM implementation. Factors which need to be taken into consideration during this assessment are as follows (note that this should not be construed as an exhaustive list):

- Whether demand exceeds capacity on a regular basis in either airspace or **at** airports.
- Whether there are periods of high workload on ATC followed by periods of minimal traffic.
- Whether there are initiatives to increase capacity that are in line with predicted demand.

- What is the anticipated growth in traffic movements and whether that demand will exceed resource capacity in the future.
- What are the military airspace and operational impacts on capacity of airspace.
- Whether there are significant increases in seasonal demand (holiday season) resulting in demand exceeding capacity.
- Whether airlines are experiencing increased sector times.
- Whether there are noise abatement procedures causing reduction in capacity.
- Whether there is excessive airborne holding, vectoring, speed control, and/or surface queuing.
- Whether there are capacity constraints (e.g., weather, very important person [VIP] movements, sporting events, military exercises, frequent equipage outages, political unrest, labour issues).
- Whether there are flights that depart from airfields within their area of jurisdiction to other FIRs where ATFM measures are in place.
- Participation in Cross-Border ATFM initiatives.
- What is the ratio of domestic traffic versus international and regional traffic.
- Whether there are multiple resources (airports or airspace) within the area of jurisdiction which require ATFM/CDM.
- What is the type and equipage of aircraft fleet.
- What are the Communication, Navigation, and Surveillance (CNS) capabilities of ANSP.
- Are major changes in CNS equipage changes likely to affect capacity during implementation.
- What are airport resources and processes (Airport Collaborative Decision Making [A-CDM]).

- Once the requirements are identified a gap analysis needs to be carried out to establish the existing baseline, technical capabilities, and develop ATFM implementation requirements for the State concerned.

ATFM/CDM ConOps

3.6 Once the ATFM/CDM implementation Requirements are established, the ANSP will need to develop a ConOps for its area of responsibility. This ConOps could be limited to one or be a combination the ATFM/CDM ConOps described in the following sections.

Domestic ATFM

3.7 The State may have the required number of domestic flights to make Domestic ATFM effective without including regional and international flights. As previously stated, it has been calculated that a minimum of 70% participation of flights in an ATFM program such as a Ground Delay Program (GDP) is the minimum required to gain operational and efficiency benefits. In this chosen option, only domestic flights will be subjected to ATFM measures; regional and international flights may be exempt. While a State may have enough domestic flights for ATFM to be implemented, it is advisable that a concept including regional and international flights is considered to ensure the distribution of delay is fair, equitable, and efficient.

3.8 Examples of Domestic ATFM/CDM implementations (South Africa, Australia, and Japan); have all recognised the requirement to include regional and/or international flights in ATFM measures. South Africa is considering including flights from surrounding States, and Australia is planning to include long-range flights in its ATFM program. Japan is part of the North Asia Regional ATFM Harmonisation Group (NARAHG) regional group which is considering how to develop Cross-Border ATFM/CDM in this sub region.

3.9 In APAC, ANSPs may initially implement Domestic ATFM/CDM; however, long-term plans should be to "upgrade" to Cross-Border Regional ATFM.

Key components of the Domestic ATFM/CDM concept.

- System Capability and functionality
  - ANSP independently manages demand/capacity of its own Airport(s).
  - Only domestic traffic is subject to ATFM measures.
  - Stakeholders/ANSPs communicate via Internet/Telecommunications networks.
  - CDM is performed by stakeholders via software web interfaces.
- Specify Capacity and Predict Demand
  - Demand Prediction – Flight progress is via manual input or automated data feed (e.g., FDP or AFTN).

- Capacity Management – Inputs from FMP and FOC are via ATFM web-based interface.

- Evaluate Alternatives, Initiate/Modify ATFM Measures
  - Domestic Aircraft Operators manage the ATFM Measure delay assigned to flights.
  - Slot assignments can be viewed via software web interface and notifications.

Cross Border Regional ATFM/CDM

3.10 While it is not envisaged any state will implement a Cross Border Regional ATFM/CDM ConOps in isolation, the Cross Border Regional ATFM/CDM ConOps is explained for understanding.

3.11 A State/ANSP implements and operates a single independent ATFM/CDM system applicable to their environment which would comprise a single ATFM entity employing concepts as described in the Regional ATFM ConOps. Implementation of this concept does not require a "Node" and can be implemented by an ANSP that implements an ATFM measure for a single resource. Key components of the Cross Border Regional ATFM/CDM ConOps include:

- Regional acceptance of the APAC Regional ATFM ConOps
  - Stakeholders agree to the adoption of the APAC Regional ATFM ConOps irrespective of the ConOps adopted in their area of jurisdiction.
  - States commit to planning commitments for ATFM/CDM implementation.
  - All stakeholders commit to time lines set for APAC Cross-Border Regional ATFM implementation.
  - Agreement to a common set of procedures for departure, destination and en-route ANSPs, Airport Operators, and Aircraft Operators. Continued education of all stakeholders of the benefits, both qualitative and quantitative, of ATFM/CDM implementation. Participating ANSPs to initiate the effort to build their individual capabilities and practise ATFM in accordance to ICAO guidance to provide ATFM service

- Cross Border Regional ATFM ConOps
  - ANSP has an independent ATFM System.
  - An ANSP implements ATFM even though surrounding states have not done so.
  - ANSP independently manages demand/capacity of its own resources.
  - To achieve at least 70% flight participation, regional, international, and possibly airborne flights are required to be included in ATFM Measures.
  - Agreements with ANSPs having flights departing from their airspace to ANSPs with Cross Border Regional ATFM ConOps operating to respect CTOTs and Controlled Times Over (CTOs) as issued.
  - Implementation of this concept does not require a "Node" (as described in Cross-Border Multi-Nodal Regional ATFM/CDM).

- Agreement to a common set of procedures for departure, destination, and en-route ANSPs, Airport Operators, and Aircraft Operators.
- Participating ANSPs to initiate the effort to build their individual capabilities and practise ATFM in accordance to ICAO guidance to provide ATFM service.
- Participating stakeholders connected via Internet interfaces.
- Continued education of all stakeholders of the benefits both qualitative and quantitative of ATFM/CDM implementation.

- Specify Capacity and Predict Demand
  - Demand Prediction – Flight progress is via manual input or automated data feed (e.g., FDP or AFTN).
  - Capacity Management – Inputs from FMP and FOC are via ATFM web-based interface.
- Evaluate Alternatives, Initiate/Modify ATFM Measures
  - Aircraft Operators manage the ATFM Measures delay assigned to flights.
  - Aircraft Operators perform CDM with Airport Operators for ground/surface delay intent.

3.12 In addition to including airborne and international flights into ATFM measures, the Regional concept has a future enhancement which envisages Aircraft Operators may specify their assigned program delay to various stages of the flights; Gate, Surface (between gate and departure), or en-route. This ability for Aircraft Operators to specify their delay intent gives additional operational flexibility to achieve the same result.

Cross-Border Multi-Nodal Regional ATFM/CDM

3.13 A State/ANSP implements and operates an ATFM system based on the application of remote CTOT delivery impacting multiple FIRs/ sectors of airspace or airports coordinated via one single node within the country. See **Error! Reference source not found.**.

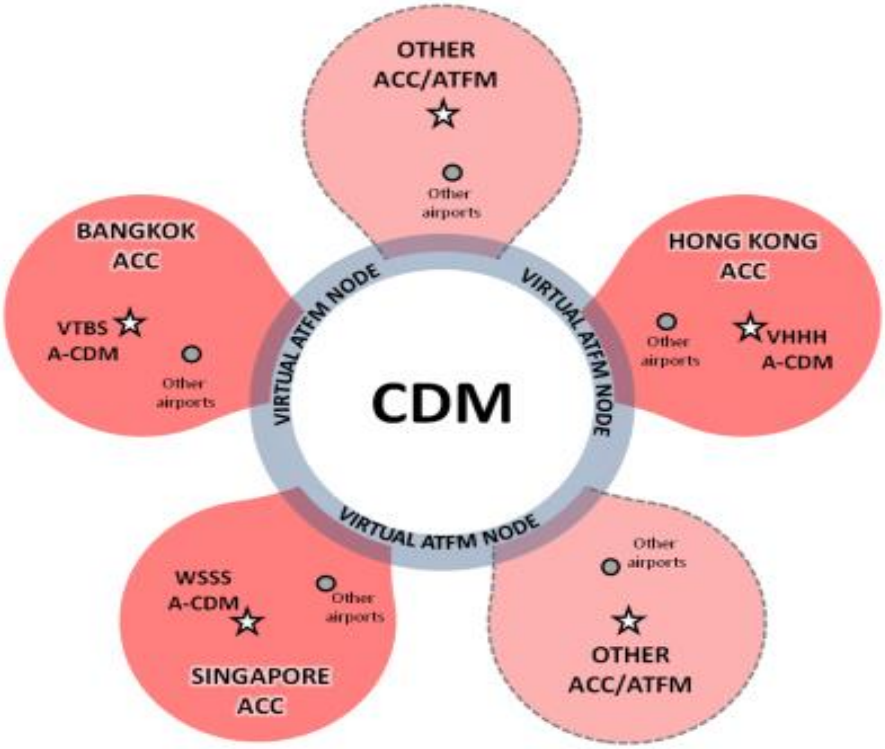


Figure 5: Distributed Multi-Nodal ATFM Network concept

3.14 In this concept, each ANSP operates an independent, virtual ATFM/CDM node (they are responsible for ATFM/CDM within their area of responsibility) supported by an interconnected information-sharing framework. The flows of air traffic will then be effectively managed based on a common set of agreed principles among the participating ANSPs and airports. A node comprising of the ANSP and associated airports will be able to manage the demand and capacity through adjustments in aircraft Calculated Landing Times (CLDTs) which will in turn generate CTOTs for particular aircraft at the departure airport.

3.15 An ANSP performs demand and capacity balancing within their own area of authority and where ATFM measures require participation of regional and international flights, the flows will be managed by the agreed coordination procedures.

Key components of the Cross-Border Multi-Nodal Regional ATFM/CDM concept

3.16 Key components of the cross-border ATFM/CDM concept, to be considered in conjunction with the Regional ATFM Conops and Regional ATFM Framework, are:

- Multi-Nodal Stakeholders interconnected via virtual communication framework
  - Each ANSP has an independent ATFM System.
  - Each ANSP independently manages demand/capacity of its own Airport(s).

- Common agreement to share essential data for ATFM by all Multi-Nodal stakeholders.
- Stakeholders/ANSPs communicate via existing Internet/Telecommunications networks.
- Harmonized and integrated data exchange between all stakeholders in the Multi-nodal network.

- Specify Capacity and Predict Demand
  - Demand Prediction – Flight progress is via manual input or automated data feed (e.g., FDP or AFTN).
  - Capacity Management – Inputs from FMP and FOC are via ATFM web-based interface.
- Evaluate Alternatives, Initiate/Modify ATFM Measures
  - Aircraft Operators manage the ATFM Measures delay assigned to flights.
  - Aircraft Operators perform CDM with Airport Operators for ground/surface delay intent.
  - Slot assignments can be viewed via software web interface and notifications.

Regulatory Aspects for ATFM/CDM Implementation

3.17 The support of the regulatory authority is critical for successful ATFM implementation. The regulator must be involved in ATFM planning an implementation at the very earliest opportunity. All ICAO and ANSP/Regulator requirements will need to be complied with prior to ATFM/CDM implementation. In addition, adherence to the Regional ATFM Framework ensuring a "seamless" ATFM/CDM process between FIRs in the region.

3.18 It will be a requirement to perform a safety assessment prior to implementation of ATFM/CDM as per ICAO Document *Annex 11* (Section 2.7).

Publication of information

3.19 ANSPs will be required to comply with normal Aeronautical Information Publication (AIP) processes to ensure the implementation of ATFM/CDM is communicated with the aviation community.

3.20 Experience shows that early and on-going communication in the form of written, workshop and training in addition to the required formal AIS process is a very important factor in gaining “buy-in”, acceptance and support from the operational stakeholder community.

It is also recommended that all stakeholders publish in-house in house education material and formal procedures for ATFM/CDM processes.

IMPLEMENTATION RISKS AND MITIGATION

General risks and mitigation of Cross-Border ATFM/CDM implementation

4.1 **Tables 2 - 14** summarise the general risks and mitigation for Cross-Border ATFM/CDM implementation.

Definition:	ANSP does not abide by regional ATFM procedures.
Result:	Aircraft departing from within the airspace of non-participating ANSPs.
Mitigation:	Education on benefits of participation for region
Probability/Impact:	Medium

Table 2: Risk 1 – Non-participation by ANSP in Regional ATFM ConOps

Definition:	Airline does not abide by Regional ATFM procedures
Result:	Aircraft are non-compliant.
Mitigation:	Urge participation by direct contact with concerned non-compliant airlines
Probability/Impact:	Medium

Table 3: Risk 2 – Non-participation by Airline in Regional ATFM ConOps

Definition:	Airport Authority does not accept ATFM concept and does not allow airlines to absorb delay at gate and on the ground either at the gate or between pushback and departure.
Result:	Aircraft unable to absorb delay on the ground and becoming non-complaint.
Mitigation:	Education and convincing airport authorities of network benefits for ATFM implementation.
Probability/Impact:	Medium

Table 4: Risk 3 – Non-participation by Airport Operator

Definition:	Cross-Border Multi-Nodal Regional ATFM/CDM is not implemented.
Result:	Safety impact of congested airspace leading to ATC/Pilot overload, inefficiencies, excessive fuel burn and carbon dioxide (CO_2) emissions.
Mitigation:	Popularise ATFM/CDM via all available means and to all possible stakeholders explaining benefits is very significant.
Probability/Impact:	High

Table 5: Risk 4 – Non-action with respect to Cross-Border Regional ATFM

Definition:	Awareness and hence commitment of one or more stakeholders is lacking during project planning or actual implementation.
Result:	Delayed or inefficient implementation.
Mitigation:	Comprehensive promoting and communication needed, early and continued benefits demonstrated at the airport to raise awareness.
Probability/Impact:	Low

Table 6. Risk 5 – ATFM/CDM awareness not sufficient amongst stakeholders

Definition:	Not adhering to functional requirements when defining system and implementation.
Result:	Implementation can be put in jeopardy, implementation may become fragmented.
Mitigation:	Basic and agreed principles and Regional ATFM procedures to be followed. The Regional ATFM Framework must be respected and maintained but can be enhanced in line with implementation maturity.
Probability/Impact:	Medium

Table 7: Risk 6 – Implementation not consistent with Cross-Border Regional ATFM principles or Regional ATFM procedures

Definition:	Stakeholders have different or even conflicting priorities and/or interests.
Result:	Difficult to convince all stakeholders to participate.
Mitigation:	Basic and agreed principles and Regional ATFM procedures to be followed. *The Regional ATFM Framework* document must be respected and maintained but can be enhanced in line with implementation maturity.
Probability/Impact:	Medium

Table 8: Risk 7 – Conflicting interests of stakeholders

Definition:	Stakeholders reluctant to release data.
Result:	Project can be put in jeopardy, implementation may become fragmented or non–consistent.
Mitigation:	Better Education and communication. Demonstrate security features.
Probability/Impact:	High

Table 9: Risk 8 – Requirement for non-disclosure

Definition:	Unforeseen withdrawal due to political, budget restrictions, changes of priority, etc.
Result:	Non-compliant operations.
Mitigation:	Relying on airline participation to meet compliance standards.
Probability/Impact:	Medium

Table 10 Risk 9 – One or more stakeholders/States withdraw from Cross-Border ATFM/CDM

Definition:	Project may be seen of less importance/priority and reduce availability of staff, finance and resources.
Result:	Slow or non-implementation.
Mitigation:	Education and convincing management of benefits of ATFM/CDM implementation.
Probability/Impact:	Medium

Table 11: Risk 10 – Insufficient cooperation/support from Airport/Airline/ANSP management

Definition:	Poor data quality or insufficient acquisition.
Result:	Unreliable project results, poor costs/benefit ratio.
Mitigation:	Education and communication, standard acronyms and definitions to be used, standard ICDs to be used.
Probability/Impact:	Medium

Table 12: Risk 11 – Data acquisition not satisfactory

Definition:	Following initial drive to consider implementation ATFM/CDM and project preparation, one or more major stakeholders decide to not participate.
Result:	Project will stall, or implementation will have reduced effectiveness.
Mitigation:	Continued collaboration and communication on benefits of regional implementation to be undertaken.
Probability/Impact:	Medium

Table 13: Risk 12 – No go decision

Definition:	Diverse systems communicate poorly or not at all.
Result:	Difficulty for uses to access CTOT, CTO and CLDT information on various ATFM systems. Loss of confidence, benefits reduced.
Mitigation:	Use standard ICD.
Probability/Impact:	Medium

Table 14: Risk 14 – Insufficient system integration

POST-IMPLEMENTATION ACTIVITIES

ATFM/CDM becomes a daily operation

5.1 ATFM/CDM, whether Domestic or Cross-Border, will become a daily operation undertaken by all the stakeholders. Successful implementation will have shown the aviation community that for the entire supply chain to succeed, all will need to participate in the CDM process. Continued momentum and active engagement will need to be maintained.

Continued education of all stakeholders

5.2 As there might be no or partial participation by some stakeholders, continued education and benefit-proving must take place to continually increase participation by stakeholders.

Preparing for new functions

5.3 For Cross-Border programs there will be varying levels of participation of ANSPs. Therefore, there is a need for ANSPs to regularly review and apply the ATFM/CDM implementation criteria to assess if their operational and ATFM requirements have changed.

TIME LINE

6.1 Aviation System Block Upgrade (ASBU) module B0-NOPS is one of the ten Regional priorities determined by APANPIRG, and is listed among the Seamless ATM Plan's highest priority ASBU modules. In the Regional ATFM Framework, regional collaborative ATFM objectives are arranged in ATFM Capability phases, aligned where practicable, with Phases I and II of the Seamless ATM Plan's Preferred Aerodrome/Airspace and Route Specification. ANSPS should develop their ATFM/CDM implementation strategy in alignment with this plan:

- **Phase IA** – expected implementation by 12 November 2015;
  - Enact regulations for the implementation of ATFM.
  - Conduct bi-annual strategic airport and airspace capacity and demand analysis.
  - Prepare for capacity demand balancing based on demand analysis.
  - Develop and distribute an ATFM Daily Plan (ADP).
- **Phase IB –** expected implementation by 25 May 2017; and
  - Analyse operational flight plan (FPL) and ATS message distribution systems.
  - Requirements for FPL to be submitted 3 hours prior to Estimated Off Block Time.
  - Integrate ATFM, AMAN/Departure Management (DMAN), and A-CDM systems through common fixes, terminology, and communication protocols.
  - Implement strategic airport slot allocation if necessary.
  - Pre-tactical modelling of expected airport and airspace configuration and capacity demand balancing.
  - Implementation, revision, or cancellation of GDPs for inbound traffic, or minutes-in-trail (MINIT) or miles-in-trail (MIT) where CTOT may not be applied.
  - Post-Operational analysis to provide feedback for procedures and processes.
- **Phase II** – expected implementation by 08 November 2018.
  - Distributed Multi-Nodal ATFM information distribution capability utilising Flight Information Exchange Model (FIXM) version 3.0 (or later) should be implemented.
  - Full interoperability of Cross-Border ATFM, A-CDM, AMAN, DMAN, ATM automation, and Airspace User systems should be implemented, utilising FIXM 3.0 (or later), to provide seamless gate-to-gate collaborative ATFM operations.
  - Implementation of pre-tactical and tactical capacity, and demand monitoring and analysis
  - Pre-tactical GDP using CTOT for capacity demand balancing measures.
  - Tactical ATFM measures including MIT, MINIT, and where necessary, CTO at the arrival fix (AFIX) or en-route Fix (RFIX), should be applied to flights throughout constrained airspace when a GDP is not implemented.

6.2 Refer to the Regional ATFM Framework document for further information on the ATFM Capability Phases and performance objectives.

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APPENDIX A - Assessment of Benefits

An interoperable network approach for the region will result in system-wide Demand Capacity Balancing. This approach enhances the safety and optimises the efficiency of airports and available airspace. As the Asia-Pacific region, the world's largest market for air transport, continues to grow, it becomes essential to optimise the use of available capacity through ATFM. In 2013, the APAC was one of the fastest growing regions by passengers in the world (see Table **15**). The region's passenger growth was 8.5%. Individual countries with notable passenger growth include: China (11.8%), Indonesia (20.4%), and Thailand (16.4%).

	Annual % Change	Passenger Volume
Indonesia	20.4	92,534,902
Thailand	16.4	62,831,288
China	11.8	404,174,939
Singapore	7.6	42,438,276
Malaysia	7.5	51,821,210
Japan	4.9	148,450,196
India	4.4	97,677,318
Hong Kong	3.9	44,399,060
Korea, Republic of	1.2	62,166,163
Australia	0.6	81,983,309
Asia/Southwest Pacific	8.5	1,075,572,893

Table 15: Top Passenger Countries 2013 *Source: WATS 58th edition, 1.4 Top Passenger Countries*

Throughout the Asia-Pacific region, individual States' ATM and ATFM equipment, services, procedures, airspace design, communications, and resources have a wide disparity in capabilities. These limitations often result in a less efficient operational environment. Prevalent throughout the study region are excessive MIT restrictions, fuel burn, CO2 emissions, aircraft departure holding on the ground, airborne holding, and delays.

Weather and other system constraints increase schedule buffer, delayed flights, cancellations, and missed connections. Flight delays add costs to airlines, passengers, Airport Operators, and States. Aviation inefficiencies have trickle-down impacts on other sectors due to lost time and productivity. As traffic demand increases, delays will also increase if resource capacity is not increased.

The expectant results of an interoperable ATFM network of States will have potential benefits to airlines, passengers, Airport Operators, and States. Although we do not have any general figures for the region, our analysis identifies generic qualitative and quantitative benefits.

Qualitative Benefits

Regional Wide Benefits

Implementation of Regional ATFM will derive the following benefits:

- More timely and informed collaborative decision making, which takes the entire region's requirements into consideration.
- A coordinated networked ATFM approach to all air traffic flying in the region would result in a seamless optimised expeditious flow of traffic throughout the region.
- Presently there is little communication between the ANSPs relating to ATFM. With the implementation of ATFM, automated and procedural communication will be improved, enhancing not only ATFM communication, but also ATC communications.
- As ATFM develops in the region, States will be incentivised to collaborate on airspace design so as to accommodate better flows of traffic to accommodate ATM and ATFM procedures.
- Enhanced situational awareness for the region through shared information.
- As Regional ATFM matures, better planning and CDM in all phases of ATFM, including post-event analysis, will occur.
- The traditional model of ATFM implementation requires only domestic traffic to adhere to the controlled times issued. The *Regional ATFM Concept of Operations* requires all aircraft to adhere to controlled times. Therefore, States with no domestic flights, such as Hong Kong China and Singapore, can perform demand and capacity balancing.
- In the traditional model of ATFM implementation, only domestic traffic is subject to ATFM measures, therefore domestic traffic can be unfairly delayed while non-participating aircraft (international flights) are not. With the Regional ATFM Concept, all traffic is expected to be subject to ATFM measures, and the delay is distributed fairly and equitably amongst all traffic.
- Establishment of Regional ATFM will lead to enhanced information-sharing and CDM practices during extraordinary events such as volcanic eruptions (as the FAA ATCSCC and the EUROCONTROL Network Manager have collaborated during recent volcanic eruptions), disease, political unrest, and war.

ANSPs

- Smoother transition of DCB from strategic to pre-tactical and tactical phases of ATFM.
- Network-managed DCB brings about overall optimisation of airspace.
- Better planning due to accurate and common view of demand and capacity predictions.
- More timely and informed decision-making, taking the entire region's requirements into consideration

- Improved modelling and evaluation of proposed ATFM Measures in collaboration with stakeholders prior to implementation.
- Availability of a data platform that integrates various flight data sources and provides common situational awareness to the stakeholders.
- An environment in which ATFM Measures and other operational procedures can be improved through post-operational analysis.
- Improved special event and flexible usage of airspace planning.
- More efficient DCB at airports and in airspace.
- Optimisation and reduction of staffing. During peaks of un-metered traffic, ANSPs are often required to roster extra staff to cope with increased workloads. With metered flows of traffic, workload is reduced, therefore reducing staffing levels.
- Optimisation and allocation of resources (maintenance of equipment, Navigation Aid [NavAid] calibrations).
- Implementation of Performance-Based Navigation (PBN) procedures brings about many benefits to Airline Operators and ANSPs; however, if there is an un-metered flow of arrival or departure traffic, the effectiveness of PBN procedures could be negated. During times of high demand, ATC is required to vector aircraft off the PBN route in order to satisfy separation rules. Implementation of ATFM will ensure a steady stream of de-conflicted air traffic before entering the arrival phase, which will allow more aircraft to complete the full PBN approach and receive the maximum benefits. This results in reduced workload for the ATCOs and pilots.
- Improved safety.

Airline Operators

- Improved flexibility for Airline Operators to optimise their schedules through CDM.
- Improved flexibility for flights to absorb inevitable delay on the ground or efficiently through the en-route portion of the flight rather than by airborne holding in the terminal area.
- More reliable and timely access to information indicating stakeholder intent—this applies to Airline Operators sharing how they intend to operate the flights as well as to States and airports sharing any resource constraints.
- Reduced sector times resulting in reduction in schedule buffer times.
- Maximised benefits for aircraft with advanced avionics (PBN routings).
- Significant fuel savings.
- Significant reduction in CO_2 emissions.
- Better aircraft utilisation.
- Better passenger experience.
- Optimisation of staffing and allocation of resources.

- Improved safety.

Airport Operators

- With enhanced situational awareness of arrival and departure times, apron planners will be able to improve gate allocation, especially during constrained periods. This leads to better utilisation of ground resources (ground handling, catering, refuelling, etc.).
- Enhanced situational awareness assists the entire community in the airport precinct (passengers, immigration, customs, security, baggage handling, etc.).
- Optimisation of staffing.
- ATFM integrated with A-CDM will result in better turnaround times and on-time performance of Airline Operators.

Safety

- Standard ATM practices of separating and sequencing traffic by vectors, speed control, and airborne holding are carried out during un-metered peaks of traffic. These practices are proven safe and effective. However, during these peak periods, the workload on ATC and pilots can increase significantly, thereby reducing the margin for error. Through ATFM, a constant manageable flow of traffic is achieved, resulting in a more manageable workload and hence, a safer operation. A network approach to ATFM reduces sector/system saturation, increases efficiency, and enhances safety.
- Unstable approaches have been recognised as a causal factor in aircraft incidents. A possible cause of unstable approaches is excessive and unreasonable speed control and vectoring (late or greater than 30 degree Instrument Landing System [ILS] intercepts). With a metered flow of traffic, the requirement of ATCs to undertake excessive tactical sequencing management (vectors and speed control) is reduced with the possible result of fewer unstable approaches.
- As ATFM develops in the region, States will be forced to collaborate on airspace design so as to accommodate better flows of traffic to accommodate ATFM procedures.
- Often with the implementation of ATFM, States enhance their ability for severe weather detection. This earlier detection of weather is shared with Airline Operators and ANSPs, increasing situational awareness. In addition, this is taken into account when determining the capacity of resources, resulting in the correct ATFM measure being implemented, which can have a direct impact on safety.
- Communication networks will improve between States with ATFM implementation so as to accommodate CDM. A resultant benefit will be reduced coordination errors, which leads to enhanced safety.

Quantitative Benefits

The aviation industry contributes significantly to State economies. In the Asia-Pacific region, the air transport sector supported 4.8 million jobs (2012) and contributed US$265 billion to the Gross Domestic Product (GDP). Oxford Economics forecasts the number of jobs supported by aviation and tourism impacts will increase by 91% by 2032.[3]

A University of Westminster study comprehensively addresses European airline delay costs (passenger, crew, fuel, maintenance, reactionary). This study derived the average cost of delay to be US$103 per minute in 2010.4 Aviation impacts also have a trickle-down impact on other sectors due to lost time and productivity.

Successful ATFM is the optimisation of flows of traffic by balancing demand with the available system capacity. This is achieved through the implementation of flow management measures based on an accurate prediction and assessment of demand and capacity. These flow management measures transfer existing delay to a more efficient phase of operation. Efficiency encompasses many variables but typically focuses on fuel burn savings, which are impacted by aircraft type, configuration, weight, altitude, etc. While the goal is the elimination of delay, the benefit of transferring delay from the arrival phase (holding, speed control, vectoring) to ground delay for air carrier operations has resulted in an average savings of US$47 per minute in 2014. The Regional ATFM operational concept provides an additional mechanism to transfer assigned delay from the arrival phase to the en-route phase of flight. It is estimated that the benefit gained by absorbing assigned delay more efficiently is projected to yield an average savings of US$42 per minute.

Based on the IATA project team's understanding of the current (2014) Asia Pacific operating environments, publicly available and confidential assessments, a model was created to estimate fuel savings for Domestic and Regional ATFM within the Asia-Pacific region. The model assumes that under current 2014 air traffic demand and capacity, ATFM measures will be implemented, on average throughout the region, during 1.5–2 days per week. Air traffic demand in Asia Pacific is expected to grow significantly in the next five to ten years. While the growth is predicted to increase by approximately 5.5–6% annually, such an increase in demand would eventually lead to unsustainable levels of congestion and delay within the region's airport and airspace operating environments until capacity enhancements are operationally available. Based on the projected growth in the 2015–2019 timeframe, the model assumes that the frequency of ATFM measures will increase as well, on average to 2–2.5 days per week, until capacity enhancements are operationally available. Error! Reference source not found.**Table A1** summarises the projected quantitative benefits from ATFM in 2014 and in 2019.

[3] Aviation Benefits Beyond Borders, Air transport Action Group, April 2014.
[4] European airline delay cost reference values Final Report (version 3.2), University of Westminster, March 2011.

	2014	2019
Regional ATFM	US$250 – $300M	US$600M – $800M
Domestic & Regional ATFM	US$660 – $810M	US$1.1B – $1.4B

Table A1: Asia/Pacific Annual Fuel Savings Benefit Projection

Capitalising on this benefit opportunity through the network-based Asia Pacific Regional ATFM implementation is particularly important in the following airport operating environments, where international arrival traffic accounts for 35–100% of the total demand (an indication that Domestic ATFM deployments alone are not practical for demand capacity balancing at these airports):

- China - Shanghai Pudong International
- Indonesia - Ngurah Rai International
- Hong Kong - Hong Kong International
- Japan - Narita International
- South Korea - Incheon International
- Malaysia - Kuala Lumpur International
- Philippines - Ninoy Aquino International
- Singapore - Changi International
- Taiwan - Taiwan Taoyuan International
- Thailand - Suvarnabhumi Bangkok International
- Vietnam - Tan Son Nhat International and Nội Bài International

Within the remainder of the major Asia Pacific airport operating environments, international arrival traffic currently accounts for 20–30% of the total demand. Achieving the benefit of fuel savings in these environments is supported by Domestic ATFM deployments and enhanced through the Regional ATFM implementation.

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