INTERNATIONAL CIVIL AVIATION ORGANIZATION

Caribbean/South American Air Traffic Flow Management Concept of Operation

(CAR/SAM ATFM CONOPS)

2019 - 2024

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FOREWORD

The Caribbean/South American Air Traffic Management (ATFM) Concept of Operations (CAR/SAM ATFM CONOPS) is published by the B1 Project (IMPROVE DEMAND AND CAPACITY BALANCING (DCB)) of the Caribbean/South American Regional Planning and Implementation Group (GREPECAS). It describes an air traffic flow management operational concept to be applied in both regions.

GREPECAS and its contributory bodies will issue revised editions of the Document as required to reflect ongoing implementation activities.

Copies of the *CAR/SAM ATFM Concept of Operations* can be obtained by contacting:

ICAO NORTH AMERICAN, CARIBBEAN, AND CENTRAL AMERICAN OFFICE

MEXICO CITY, MEXICO

E-mail : icaonacc@icao.int
Web site : www.icao.int/nacc
Fax : +5255 5203-2757
Mail : P. O. Box 5377, México 5 D. F., México
Point of contact : Eddian Méndez
E-mail : emendez@icao.int

ICAO SOUTH AMERICAN OFFICE

LIMA, PERU

E-mail : icaosam@icao.int
Web site : www.lima.icao.int
Tel: : +511 611 8686
Fax : +511 611 8689
Mail : P. O. Box 4127, Lima 100, Peru
Point of contact: Fernando Hermoza
E-mail : fhermoza@licao.int

The present edition (Version 2.1) includes all revisions and modifications until June 2019. Subsequent amendments and corrigenda will be indicated in the Record of Amendment and Corrigenda Table, according to the procedure established in page 3.

The publication of amendments and corrigenda is regularly announced through correspondence with States, and the ICAO web site, which holders of this publication should consult. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS			
No.	Date applicable	Date entered	Entered by
1	20/06/07	20/06/07	ATFM/TF/3
2	01/01/2019	01/01/2019	ATFM/TF
2.1	27/06/2019	27/06/2019	ATFM/TF
3	30/10/2020	30/10/2020	ATFM/TF

CORRIGENDA			
No.	Date applicable	Date entered	Entered by

AMENDMENTS TO THE DOCUMENT

1. The CAR/SAM ATFM CONOPS is a regional document that includes aeronautical, scientific and technological advances related to ATFM. It also includes the operational experiences gained in the CAR/SAM Regions, as well as in other ICAO Regions, that may affect ATFM concepts and procedures.

2. Due to its unique and regional focus, the CAR/SAM ATFM CONOPS is also a dynamic document and is in continuous progress in order to accept every modification originated by the GREPECAS. This will allow for constant improvement based on experience gained from aeronautical disciplines and activities, enable its harmonious implementation in the CAR/SAM Regions, ensure air operations efficiency and maintain agreed levels of safety.

3. In order to keep this ATFM CONOPS updated and make the required changes and/or modifications, the following amendment procedures have been established.

4. The ATFM CONOPS consists of a series of loose-leaf pages organized in sections and parts describing the concepts and procedures applicable to ATFM operations in the CAR/SAM Regions.

5. The framework of the sections and parts, as well as the page numbering, have been developed so as to provide flexibility, for review and revision of the various sections. Each section is independent and includes an introduction defining its purpose and status.

6. Pages bear the date of publication, as applicable. Replacement pages are issued as necessary and any portions of the pages that have been revised are identified by a vertical line in the margin. Additional material will be incorporated in the existing Sections or will be the subject of new Sections, as required.

7. Changes to text are identified by a vertical line in the margin in the following manner:

Italics	*for new or revised text;*
Italics	*for editorial modification which does not alter the substance or meaning of the text; and*
Strikethrough	~~for deleted text.~~

8. The absence of change bars, when data or page numbers have changed, will signify re-issue of the section concerned or re-arrangement of text (e.g. following an insertion or deletion with no other changes).

Page

Document content

GLOSARIO DE ACRÓNIMOS/ GLOSSARY OF ACRONYMS

ACC	Centro de control de área Area Control Centre
A-CDM	Airport Collaborative decision-making Toma de decisiones en colaboración a nivel aeropuerto
AFTN	Red de telecomunicaciones fijas aeronáuticas Aeronautical Fixed Telecommunication Network
AIP	Publicación de Información aeronáutica Aeronautical Information Publication
AIS	Servicio de información aeronáutica Aeronautical Information Service
ANP	Plan de navegación aérea Air Navigation Plan
ANS	Servicios de navegación aérea Air Navigation Services
ANSP	Proveedor de servicios de navegación aérea Air Navigation Service Provider
AO	Explotador de aeronave Aircraft Operator
APP	Oficina de control de aproximación Approach Control Office
ATC	Control de tránsito aéreo Air Traffic Control
ATFM	Gestión de afluencia del tránsito aéreo Air Traffic Flow Management
ATM	Gestión del tránsito aéreo Air Traffic Management
ATS	Servicios de tránsito aéreo Air Traffic Services
CAA	Autoridad de aviación civil Civil Aviation Authority
CAR/SAM	Regiones Caribe y Sudamérica Caribbean and South America Regions
CATFM	Dependencia de Gestión de la afluencia del tránsito centralizada Centralized Air Traffic Flow Management Unit
CBA	Análisis de costo-beneficios Cost-Benefit Analysis
CDM	Toma de decisiones en colaboración Collaborative decision-making
CNS/ATM	Comunicaciones, navegación y vigilancia/Gestión del tránsito aéreo Communications, Navigation and Surveillance/Air Traffic Management
FDPS	Sistema de procesamiento de datos de vuelo Flight Data Processing System
FIR	Región de información de vuelo Flight Information Region
FMU	Dependencia de organización de la afluencia Flow Management Unit
FMP	Puestos de gestión de la afluencia Flow Management Position

FPL	Plan de vuelo Flight Plan
GREPECAS	Grupo regional de planificación y ejecución CAR/SAM CAR/SAM Regional Planning and Implementation Group
MET	Servicios meteorológicos para la navegación aérea Meteorological Services for Air Navigation
OACI/ICAO	Organización de aviación civil internacional International Civil Aviation Organization
PANS ATM	Procedimientos para los servicios de navegación aérea –Gestión de tránsito aéreo Procedures for Air Navigation Services –Air Traffic Management
PIRG	Grupo regional de planificación y ejecución Planning and Implementation Regional Group
TBD	A ser determinado To be determined
TMA	Area de control terminal Terminal Control Area
TWR	Torre de control Control Tower
WWW	Red informática mundial Worldwide Web

Explanation of terms and expressions

The writing and explanation of some terms and particular expressions used in this document are defined for a better understanding.

Air traffic management system. A system that provides ATM through the collaborative integration of humans, information, technology, facilities and services, supported by air and ground- and/or space-based communications, navigation and surveillance.

Capacity (for ATFM purposes). The maximum number of aircraft that can be accommodated in a given time period by the system or one of its components (throughput).

Demand. The number of aircraft requesting to use the ATM system in a given time period.

Efficiency. The ratio of the cost of ideal flight to the cost of procedurally constrained flight.

Homogeneous ATM area. An airspace with a common air traffic management interest, based on similar characteristics of traffic density, complexity, air navigation system infrastructure requirements or other specified considerations wherein a common detailed plan will foster the implementation of interoperable CNS/ATM systems.

Note.— Homogeneous ATM areas may extend over States, specific portions of States, or groupings of States. They may also extend over large oceanic and continental en-route areas. They are considered as areas of shared interest and requirements.

Major traffic flow. A concentration of significant volumes of air traffic on the same or proximate flight trajectories.

Note.— Major traffic flows may cross several homogeneous ATM areas with different characteristics.

Routing area. A defined area encompassing one or more major traffic flows for the purpose of developing a detailed plan for the implementation of interoperable CNS/ATM systems.

Note.— A routing area may cross several homogeneous ATM areas with different characteristics. A routing area specifies common interests and requirements among underlying homogeneous areas, for which a detailed plan for the implementation of CNS/ATM systems and procedures either for the airspace or for the aircraft will be specified.

Centralized ATFM. A centralized unit responsible for the provision of air traffic flow management within a specific area.

ATM Community. All the organizations, bodies or entities which might participate, collaborate and cooperate in the planning, development, use, regulation, operation and maintenance of the ATM System.

Air Traffic Flow Management (ATFM). A service established with the objective of contributing to a safe, orderly and expeditious flow of air traffic by ensuring that ATC capacity is utilized to the maximum extent possible and that the traffic volume is compatible with the capacities declared by the appropriate ATS authority.

Air Traffic Management. The dynamic, integrated management of air traffic and airspace including air traffic services, airspace management and air traffic flow management — safely, economically and efficiently — through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground-based functions.

Flow Management Unit (FMU). A working unit established in an appropriate air traffic control facility to provide ATFM service for a specific set of ATS units, and to ensure the necessary interface between the local FMU and neighbouring FMUs with respect to air traffic flow management.

Flow Management Position (FMP). A position established at specific ATS units responsible for the day-to-day ATFM activities.

Air Traffic Volume. The number of aircraft within a defined airspace or aircraft movement area in an aerodrome, within a specific time frame.

Executive summary

International civil aviation plays a key role in the sustainable development of States and Territories of the Caribbean and South American Regions, supporting various activities and a catalyst for economic growth.

In this process, decision-making, at all levels of the national, regional and interregional aeronautical system, requires to be increasingly supported by the prediction of air traffic levels, promoting air navigation for the provision of services that can adjust much better to the needs of customers in each of the phases of the flight.

ICAO has undertaken actions well aimed at promoting global initiatives that allow the development of the provision of air navigation services at the levels expected by the demands of the aviation system, being Air Traffic Flow Management (ATFM) one of the main priorities, combined with guidance material for collaborative decision making and the implementation of ATFM systems.

At the level of the CAR/SAM Regions, this global concept is adjusted in this document that provides a regional context to ICAO's global plans for the ATFM.

The CAR/SAM Planning and Implementation Regional Group (GREPECAS) has been promoting the ATFM operational concept for the CAR/SAM Regions for just over a decade, assuming the implementation of ATFM as a valuable tool, which, if well used, would serve as a guarantee for safety and efficiency of the air navigation system of both regions.

This document proposes a high-level description of the ATFM operational concept of the CAR/SAM Regions, and integrates in this development process the main actors of the ATFM system, adjusting to the growth forecasts and traffic routing that connects the entire continent and other regions of the globe.

The principles set out for ATFM are based on collaboration to achieve continuous improvement of the components of the air navigation system of the CAR/SAM Regions, recognizing that airspaces are a limited resource whose management should serve to improve safety, capacity and efficiency of air operations.

The appropriate combination of competent personnel and technology continues to be our priority to develop ATFM systems that respond in a coherent way to the system they support, in order to evolve to an environment based on measurement and progressive improvement of performance. The development of a mechanism for regional decision-making on traffic management measures is our main challenge, for which we will continue working, raising awareness among all those involved in the civil aviation system of our regions.

1. Background

1.1 The purpose of ATFM is to balance demand and capacity, providing the framework to take collaborative decisions to make an efficient use of available resources for the provision of air traffic services. Air operators and other stakeholders expect the Air Navigation Service Providers (ANSPs) take appropriate measures to ensure safety in air operations, while guaranteeing the best possible use of the airspace and movement areas.

1.2 ANSPs should be aware on the impact their traffic management initiatives have in the efficiency and safety of air transport. A number of options shall be analysed, Domestic ATFM, Cross Border ATFM, Multi-nodal Regional ATFM and Centralized ATFM.

1.3 The initial regional ATFM implementation principle for the CAR/SAM Regions was to establish two centralized ATFM Facilities, one for each Region, with the support of Flow Management Positions (FMPs) established in each Area Control Centre (ACC) within the Region of application. Consequently, States, Territories and International Organizations may define whether a Flow Management Unit, and the associated Flow Management Positions, should be established in the interim phase before the implementation of the Centralized ATFM Facility can be accomplished. This should be considered as the ideal scenario for regional ATFM implementation, aligned with implementation of modules/elements of Network Operations (NOPS) (B0, B1 and B2) of Global Air Navigation Plan (GANP) 6th edition.

1.4 However, the establishment of a single ATFM organization for each region was not feasible due to political and institutional considerations, which resulted in a considerable delay in the expected implementation of ATFM in the CAR and SAM Regions. In response to these circumstances, the CAR/SAM CONOPS makes emphasis on a multi-nodal cross border ATFM concept.

1.5 In view of the above, this document describes the main regional objectives of the ATFM, which include: assist Air Traffic Control (ATC) in making the maximum use of its airspace and capacity; issue flow management initiatives, as required, in order to maintain a safe, orderly and expeditious flow of air traffic; ensure that air traffic volume is compatible with declared capacities; develop a description of the principles and functions of flow management units; and establish the requirements for FMUs including equipment and personnel.

1.6 In the current operational concept, GREPECAS establishes a simple implementation strategy in order to ensure maximum utilization of available capacity and to permit all parties concerned to obtain sufficient experience. The implementation will be initiated with the application of basic ATFM procedures in airports, terminal and en-route airspaces and in an evolutionary manner to reach more complex phases, without the immediate need for a regional ATFM centre.

1.7 Regardless of the fact that the proposed version of the CAR/SAM ATFM CONOPS emphasizes a multi-nodal and decentralized implementation of ATFM, experience in other regions proves that this approach is not totally free of challenges. Although the multi-nodal approach may be an appropriate option for the implementation and development of ATFM capabilities by CAR/SAM States and ANSPs, this does not exclude the possibility that one or more States may wish to join to create a centralized ATFM facility for a group of States. A centralized ATFM facility comprised of and for multiple States or ANSPs does not inhibit a multi-nodal concept of operation. Both approaches can exist simultaneously, as this centralized ATFM facility would remain a contributor to the larger regional multi-nodal ATFM goal to effectively manage air traffic flow and ATFM implementation throughout the region. This approach will require regional and cross-border ATFM agreements.

1.8 Finally, GREPECAS deemed it pertinent to establish exceptions for the application of ATFM measures for aircraft performing ambulance flights, humanitarian flights, search and rescue operations and State aircraft in international flights, leaving at the discretion of the States/Territories and International Organizations the measures to be adopted on this matter for domestic flights. It also set out that for a partial or total interruption of flow management and/or support services the corresponding contingency plan will also be applicable.

2. Purpose of the Document

2.1 The CAR/SAM ATFM CONOPS document is a high level description of service to be provided in the CAR/SAM Regions during the period 2019 - 2024. It explains the current situation, as well as the future situation, which will be reached through a series of specific stages.

2.2 The operational concept described herein reflects the expected order of events and should assist and guide the planners in the design and gradual development of the ATFM system. The concept is designed to promote safety, efficiency, and an optimum flow of traffic in areas where demands exceed, or is forecasted to exceed, the available capacity of the ATM system or airport capacity.

3. Actors Involved in ATFM

3.1 The ATFM community includes organizations, bodies or entities which could participate collaborate and cooperate in the planning, development, utilization, regulation, operation and maintenance of ATFM system. Among them, the following may be emphasized:

3.2 ***Aerodrome Community***. Includes aerodromes, aerodromes authorities and other parties involved in the provision and operation of the physical infrastructure needed to support the take-off, landing and ground handling of aircraft.

3.3 ***Airspace Providers***. Refers in general terms to Contracting States in their owner capacity with legal authority to permit or deny access to their sovereign airspace. The expression may also be applied to organizations of the State to which the responsibility has been assigned to establish standards and guidelines for the airspace use.

3.4 ***Airspace users***. Refers to airline, military, and general aviation aircraft operators and pilots.

3.5 ***ATM service providers.*** Refers to all the organizations and personnel (e.g., controllers, engineers, technicians) involved in the provision of ATM services to airspace users.

3.6 ***Military aviation.*** Refers to the personnel and material of military organizations in their vital role as wardens in States' security.

3.7 ***International Civil Aviation Organization (ICAO)***. Considered as the only international organization responsible for efficiently coordinating the implementation activities of global ATM which lead to a real, continuous global ATM.

3.8 The ATFM will be implemented, as required, through regional air navigation agreements or, if necessary, by means of multilateral agreements with other States. In these agreements, procedures and common methods on capacity calculation should be considered.

4. Trends and Passenger Traffic Forecast in the Main Airports of the CAR/SAM Regions

4.1 According to the ICAO Circular 333-AT/190, *Global Air Transport Outlook to 2030*[1], CAR/SAM Regions[2] are enjoying increasing political stability and the emergence of Brazil as a major industrial and economic power with help boost traffic growth. Other nations are currently addressing political and economic concerns, but still have considerable potential for growth in the medium term.

4.2 Total passengers traffic grew annually by 6.2% between 1995 and 2010. Forecasts nevertheless call for a slightly lower but healthy annual growth rate of 5.9% up to 2030. By 2030 CAR/SAM Regions markets are expected to account for 74% of the total passenger traffic from-to-within the Regions.

4.3 All-cargo traffic will total 72 % of the intra-regional cargo traffic. The developing economy will grow 4.0 % a year in term of GDP, and the total cargo traffic related to these regions will grow 5.6%.

4.4 Air passengers traffic on domestic routes is expected to grow at an average rate of 6.5% annually between 2011-2030. Brazil and Mexico represent the most important domestic markets. Rising personal incomes and LCCs (low cost carriers) will drive future traffic increases.

4.5 Intra-regional passenger traffic is expected to grow at an average annual rate of 7.4% between 2011-2030. Between 1995 and 2010 a robust growth of 7.1 % per year was realized for the passenger market. Strong economic fundamentals and declining yields have contributed to the traffic growth. LCCs have been active in developing intra-regional routes.

5. Main Traffic Flows

5.1 The CAR/SAM air navigation plan has identified several airspaces with common interests as regards air traffic management, based on similar characteristics of traffic density, complexity and air navigation system infrastructure requirements within which a common plan shall foster the implementation of the ATM Global Concept. Within these routing areas, the main traffic flows have also been identified following the same or close flight trajectories between pairs of cities.

5.2 These routing areas and the respective traffic flows are described in the Table shown as **Appendix A** to this document.

[1] Published in 2013

[2] Circular 333-AT/190 considers “Latin America and the Caribbean Region”

6. Identification of Areas and/or Routes where Traffic Congestion is Produced

6.1 Currently, saturation periods have been identified in several airports and traffic flows *in* some portions of the CAR/SAM Flight Information Regions (FIRs). In view of this, it is necessary that CAR/SAM States, Territories, and International Organizations determine the nominal capacity of the airspace and/or airports for which they are responsible. This nominal capacity should be kept current and disseminated to all interested parties at least once per annum. If States or ANSPs determine that demand for available resources routinely exceeds the nominal capacity, a list of these periods and areas shall be made available to interested parties at least once per annum.

7. Objectives, Principles and Functions of Air Traffic Flow Management.

7.1 According to ICAO *Manual on Collaborative Air Traffic Flow Management*, Doc 9971 3rd Edition 2018, the objectives of ATFM consist of:

a) enhancing the safety of the ATM system by ensuring the delivery of safe traffic densities and minimizing traffic surges;
b) ensuring an optimum flow of air traffic throughout all phases of the operation of a flight by balancing demand and capacity;
c) facilitating collaboration among system stakeholders to achieve an efficient flow of air traffic through multiple volumes of airspace in a timely and flexible manner that supports the achievement of the business or mission objectives of Airspace Users (AUs) and provides optimum operational choices;
d) balancing the legitimate, but sometimes conflicting, requirements of all AUs, thus promoting equitable treatment;
e) reconciling ATM system resource constraints with economic and environmental priorities;
f) facilitating, by collaborating with all stakeholders, the management of constraints, inefficiencies, and unforeseen events that affect system capacity in order to minimize negative impacts of disruptions and changing conditions; and
g) facilitating the achievement of a seamless and harmonized ATM system while ensuring compatibility with international developments.

Objective of the Flow Management Unit

7.2 As established in ICAO Doc 9971, each State shall ensure that an air traffic flow management structure is developed that meets the needs of the aviation community.

7.3 The objective of the Flow Management Unit is to enhance efficiency and safety of air traffic operations by balancing demand and capacity. This may be accomplished by the use of Traffic Management Measures (TMMs) to maintain a safe, orderly and expeditious air traffic flow while ensuring that the traffic volume is compatible with the declared capacities. However, managing traffic flows means more than simply applying ATFM measures. Flow management entails implementing an ATFM solution, which is the combination of capacity optimization and ATFM measures. ATFM is therefore a process where, confronted with an imbalance between demand and capacity, consideration is first given to optimizing the capacity.

7.4 ATFM measures should generally only apply during periods when demand exceeds capacity and should not apply on a routine basis. The frequent application of ATFM measures suggests an imbalance between ATM capacity and traffic demand, which should be addressed in a more strategic fashion.

7.5 Consequently, States, Territories, and International Organizations shall establish a Flow Management Unit, and the associated Flow Management Positions, in their respective organizations. The implementation of a Flow Management Unit should be planned on a scalable basis, according to the emergence of imbalances indicators.

Principles in which ATFM will be based

7.6 An ATFM structure should be developed in accordance with Annex 11 and Doc 9971.

7.7 The implementation of the Flow Management Unit should be based on the following principles:

a) optimizing available airport and airspace capacity without compromising safety;
b) maximizing operational benefits and global efficiency while maintaining agreed safety levels;
c) promoting timely and effective coordination and collaboration with all affected stakeholders;
d) fostering international collaboration leading to an optimal, seamless ATM environment;
e) recognizing that airspace is a common resource for all users and ensuring equity and transparency, while taking into account security and defence needs;
f) supporting the introduction of new technologies and procedures that enhance system capacity and efficiency;
g) enhancing system predictability, helping to maximize aviation economic efficiencies and returns, and support other economic sectors such as business, tourism and cargo;
h) constantly evolving to support an ever-changing aviation environment; and
i) using the collaborative decision making (CDM) process as the basis for developing and implementing ATFM measures.

*Note.- **Appendix B** to this document contains "General consideration for CDM process".*

Functions of a Flow Management Unit

7.8 To provide ATFM service, the Flow Management Unit should*:*

a) Establish and maintain a database that includes:
- the air navigation infrastructure, ATS units and registered aerodromes;
- pertinent ATC sector and airport capacity; and
- forecast flight data.

b) Establish a method for displaying:
- a chart and timeline of forecast air traffic demand;
- a comparison of demand and available capacity for areas airports and airspace; and
- the time-frame of forecast air traffic demand overloads.

c) Make the appropriate coordination to attempt to increase available capacity, when necessary.

d) When demand will exceed available capacity, coordinate, communicate, and apply the least restrictive traffic management measures in a timely manner.

e) Conduct post-operational analysis on the result of traffic management measures used.

f) Coordinate traffic management measures with neighbouring FMUs and stakeholders, when so required.

g) Provide Key Performance Indicator (KPI) to ATM planning, in order to guide the increment of the ATC/airport capacity where necessary.

8. Equipment Requirements for a Flow Management Unit

8.1 The implementation of ATFM in the CAR/SAM Regions requires identifying and determining the minimum equipment requirements and communication links for implementing an FMU and FMP. Equipment implementation should be planned in a scalable basis. The objectives of ATFM tools and capabilities are to provide the best possible information to the right stakeholders at the right time. Accurate and timely demand and capacity predictions improve ATFM decision-making to provide appropriate flow solutions that meet operational requirements, utilize airspace and aerodrome capacity effectively and efficiently, and cause the least operational impact to the stakeholders as well as neighbouring ANSPs. ATFM tools provide a platform for common situational awareness, improved decision support, reduced ground and in-flight delays, improved fuel efficiency resulting in reduced CO_2 emissions, analysis of performance, and transparent and robust collaborative decision-making processes. The digital exchange of all relevant data between neighbouring ANSPs of the CAR/SAM Regions and the stakeholders is an essential element of ATFM to ensure a common understanding of demand and capacity between the CAR/SAM service providers and airspace users.

8.2 ATFM tools and capabilities should be implemented and integrated by the CAR/SAM States and ANSPs to improve ATFM demand and capacity predictions, practices, solutions, safety, post-operational analysis, and collaborative decision-making. The recommended tools and capabilities should provide the following capabilities:

Phase I (fundamental):

- Display and manually alter the aerodrome and airspace capacity;
- Display, predict, and monitor the aerodrome and airspace demand during pre-tactical and tactical phases;
- Display current and predicted weather information; and
- Operational information system to exchange and display aeronautical information such as NOTAM, TMM, advisories, etc.

Phase II features (intermediate):

- The capability to produce/obtain convective weather, ceilings, and visibility to provide aerodromes and airspace capacity estimation;
- The capability to automatically detect and inform the predicted demand and capacity imbalances for aerodromes and airspaces; and
- The capability to model solutions to address demand and capacity imbalances for aerodromes and airspaces.

Phase III features (advanced):

- The capability to implement to address demand and capacity imbalances for aerodromes and airspaces;
- Automated collaborative ATFM solutions to manage peak flows involving departure slots, rate of entry into a given piece of airspace, requested time at a way-point or a FIR/sector boundary, and re-routing of traffic to avoid saturated areas;
- Automatic exchange of ATFM measure, demand, and capacity information to operationally adjacent ATFM systems;
- Operational performance reports to support analysis and alignment with agreed KPIs for post operational reviews to promote continuous improvement; and
- Simulation and human-in-the-loop exercise capabilities to allow ANSPs and stakeholders to model and assess ATFM operational scenarios and solutions to improve operational concepts and procedures.

9. Human Resource Planning Requirements for a Flow Management Unit

Note: The following model of a FMU has been given as a reference, taken from a Federal Aviation Administration (FAA) organization. States must define their own organization according to operational needs and suitable resources.
Some CAR/SAM States do not need this kind of structure, just a couple of people to monitor capacity and demand for ATM planning purpose and to identify the need to implement an FMU in the future.

9.1 Establishment of a FMU, and associated FMP(s), requires careful human resource planning.

9.2 Proposed FMU Structure

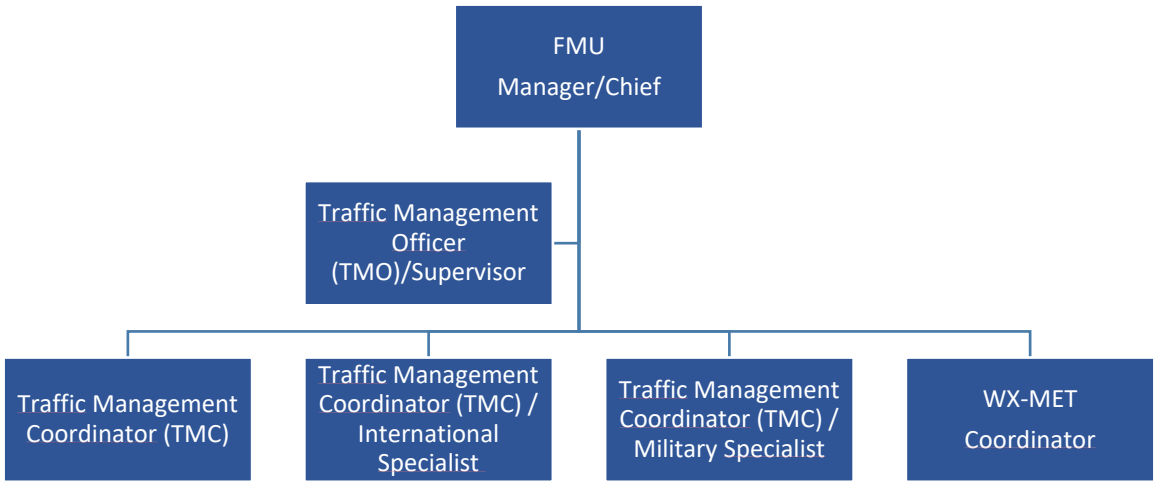


Figure 1: FMU Structure

9.3 Duties and Responsibilities: FMU Manager/Chief

9.3.1 Title of the Position: FMU Manager/Chief

9.3.2 Job Nature and Mission: Responsible for the planning, execution, and management of functions related to the operational activities in the FMU. Ensures that efficient and effective traffic management is applied within the geographic area of responsibility. Maintains an understanding of the technical aspects of the FMU and effectively manages human resources.

9.3.3 Direct Report

FMU Location: Area Control Centre (ACC)
FMU Manager/Chief reports directly to: Air Traffic Services Manager
Supervises directly: Traffic Management Officer (TMO)/Supervisor

9.3.4 Collaborative Liaison: The FMU Manager/Chief ensures that the FMU staff maintains an effective and collaborative liaison with internal and external organizations.

Internal organizations can include, but are not limited to:

- ACC staff
- Underlying Terminal Management Areas (TMAs)
- Airport Traffic Control Towers (ATCTs)
- CNS/Technical Operations staff
- Search and Rescue (SAR) Office
- Air traffic services reporting office (ARO)
- Meteorological services (MET)
- Notice to Airmen (NOTAM) Office

External organizations can include, but are not limited to:

- Adjacent ACCs and FMUs
- Airport Collaborative Decision Making (A-CDM) facilities/units concerned
- Stakeholders: airlines, general aviation, military
- Government agencies

9.3.5 Responsibilities

FMU Manager/Chief responsibilities include:

- Collaborates and communicates with operational stakeholders
- Ensures the FMU monitors:
  - air traffic flows
  - air traffic demand and capacity
  - conditions that impact demand and capacity
- Ensures the FMU staff:
  - delivers information regarding the status of the infrastructure of air navigation services. For example, NAVAIDS, airports, facilities, etc.
  - prepares, delivers and briefs reports concerning the capacity and demand of ATC sectors, Airport Acceptance Rates (AAR), and Airport Departure Rates (ADR)
  - plans, coordinates, briefs, implements, monitors, revises, and cancels TMMs
  - maintains an awareness of activities in special use airspace
  - coordinates and relays information related to NOTAMs

9.4 Duties and Responsibilities: Traffic Management Officer (TMO)/Supervisor

9.4.1 Title of the Position: FMU Traffic Management Officer (TMO)/Supervisor

9.4.2 Job Nature and Mission: Serves as supervisor on-duty for Traffic Management Coordinators (TMCs) in an FMU. Ensures that efficient and effective traffic management is applied by the TMCs within the geographic area of responsibility.

9.4.3 Location and Direct Report

FMU Location: Area Control Centre (ACC)
FMU TMO/Supervisor reports directly to: FMU Manager/Chief
Supervises directly: Traffic Management Coordinators

9.4.4 Responsibilities

- Provides supervision to staff of TMCs
- Ensures that traffic instructions/restrictions are initiated in accordance with established procedures to maintain a safe and expeditious flow of traffic and minimize the impact of heavy traffic demand
- Provides training and guidance as appropriate throughout area(s) of responsibilities
- Assigns and reviews work
- Plans work and sets priorities and schedules
- Approves leave
- Prepares schedules for completion of work
- Assigns work to subordinates based on priorities
- Evaluates work performance of subordinates, ensuring equity of performance standards and ratings
- Adjusts staffing levels and work procedures to accommodate resource decisions made at higher management levels

9.5 Duties and Responsibilities: Traffic Management Coordinator (TMC)

9.5.1 Title of the Position: FMU Traffic Management Coordinator (TMC)

9.5.2 Job Nature and Mission: Performs technical level of responsibilities of considerable difficulty. Responsible for distributing collecting and monitoring data and for overseeing the ATFM activities within the respective FIR. This ensures that all stakeholders have timely and efficient access to applicable ATFM. Utilizes equipment and aeronautical tools suitable for maintaining the balance of air traffic demand and capacity in ATC sectors and at airports. Coordinates directly with adjacent FIRs/ACCs and any other overseas/international organizations.

Note. - As needed, the TMC should be assisted/supported by a TMC/international specialist, a TMC/military specialist and/or a WX MET coordinator.

9.5.3 Location and Direct Report

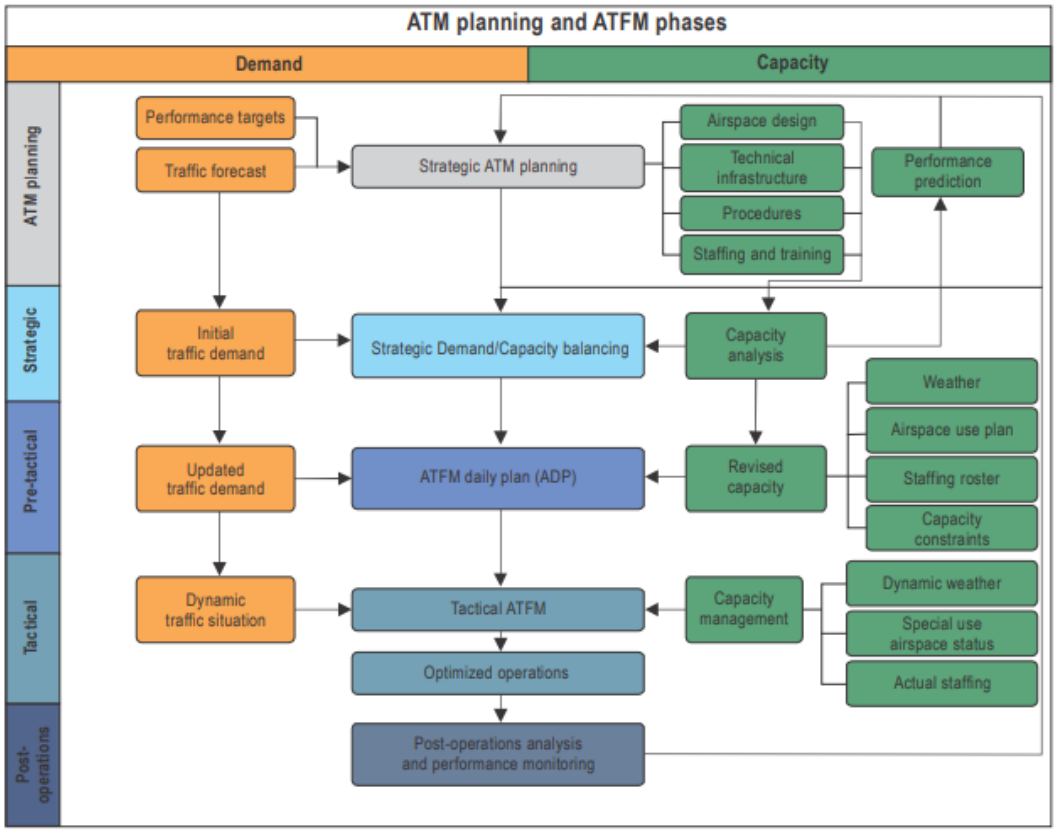
FMU Location: Area Control Center (ACC)
FMU TMO/Supervisor reports directly to: FMU TMO/Supervisor
Supervises directly: None.

9.5.4 Responsibilities

- Constantly monitors the flow of air traffic, the state of the infrastructure of air navigation services, the conditions of different airports, the weather conditions and the projected air traffic demand to ensure acceptable levels of traffic are maintained
- Monitors weather conditions and collaborates with aviation stakeholders to avoid flight routes into undesirable weather conditions
- Ensures that all stakeholders have timely and efficient access to applicable ATFM information
- Utilizes equipment and aeronautical tools suitable for balancing air traffic demand and capacity in ATC sectors and at applicable airports
- Plans, coordinates, implements, revises, and cancels traffic management measures to balance demand and capacity in ATC sectors and at applicable airports
- When air traffic delays are anticipated or known to exist, establishes plans to reduce delays
- Collects, distributes, and monitors aeronautical information pertinent to the ATFM activities within the FIR
- Ensures that the instructions and restrictions are applied in accordance with the established procedures to maintain a safely, orderly and expeditious flow of air traffic, in order to minimize the impact of high demand periods
- Coordinates directly with adjacent ACC FMUs and other overseas and international organization, as required
- Serves as a military liaison and coordinates all military exercises and activities within the designated FIR

10. Operational Procedures

10.1 A methodology to balance demand and capacity should be developed in order to minimize the effects of ATM system constraints. This can be accomplished through the application of an "ATFM planning and management" process. In this initiative, interactive capacity and airspace planning process, airport operators, ANSPs, AUs, military authorities and other stakeholders work together to improve the performance of the ATM system (see Figure II-4-1 Doc. 9971).



10.2 The operational procedures for the FMUs and FMPs should be developed in a separate document. After consultation with all applicable parties, changes, if necessary, shall be agreed upon and published as amendments to operational procedures.

10.3 The purpose of this document shall be to:

- *establish the functions and responsibilities of personnel working in the FMUs and FMPs in regard to implementing the ATFM service.*

- *describe the procedures to be used between FMUs.*

- *describe the traffic management measures that may be applied.*

10.4 Traffic management measures should be designed to address specific daily traffic flows, flight series, or specific flights. To this end, traffic management planning, strategy development, and day-to-day monitoring, should be conducted. With regard to the above, ATFM activities should be developed in three phases: strategic - more than one day prior to the day of operation; pre-tactical - one day prior to operations; and, tactical - during the day of the operation. During all three ATFM phases, responsible facilities should maintain a close liaison with system stakeholders to ensure efficient and equitable service.

Post-operations analysis

10.5 The final phase in the ATFM planning and management process is post-operations analysis. During this phase, an analytical process is carried out to measure, investigate and report on operational processes and activities. This process is the cornerstone in developing best practices and/or lessons learned that will further improve the operational processes and activities. It should cover all ATFM domains and all the external units relevant to an ATFM service.

Note.- A best practice is a method, process, or activity that, upon evaluation, demonstrates success, has had a positive impact, and can be repeated. A "lesson learned" documents the experience gained during an event and provides valuable insight with respect to identifying a method, process, or activity that should be used or, to the contrary, avoided in specific situations.

10.6 While most of the post-operations analysis process may be carried out within the ATFM unit, close coordination and collaboration with ATFM stakeholders will yield better and more reliable results.

10.7 The post-operations analysis should be accomplished by evaluating the Airside driving permit (ADP) and its results. Reported issues and operational statistics should be evaluated and analysed in order to learn from experience and to make appropriate adjustments and improvements in the future.

10.8 The process should also include an analysis of items such as anticipated and unanticipated events, ATFM measures and delays, the use of predefined scenarios, flight planning and airspace data issues. The anticipated outcome (where assessed) should be measured against the actual outcome, generally in terms of delay and route extension, while taking into account performance targets.

10.9 All stakeholders within the ATFM service should provide feedback, preferably using a standardized electronic format, enabling the information to be used in an automated manner for the post-operations analysis.

10.10 In complex areas, and in order to support the post-operations analysis process, the use of an automated replay support tool, with graphical display, can be useful.

11. ATFM Implementation Strategy

11. 1 Three elements of ATM planning must feed the ATFM system: traffic forecast, performance targets, and the general output of ATM planning. The ATM planning phase is therefore a preparatory one. Measures taken in this step include:

a) reviewing airspace design (route structure and ATS sectors) and airspace utilization policies to look for potential capacity improvements;
b) reviewing the technical infrastructure to assess the possibility of improving capacity. This is typically accomplished by upgrading various ATM support tools or enabling navigation, communication or surveillance infrastructure;

c) reviewing and updating ATM procedures induced by changes to airspace design and technical infrastructure;
d) reviewing staffing practices to evaluate the potential for matching staffing resources with workload and the eventual need for adjustments in staffing levels; and
e) reviewing the training that has been developed and delivered to ATFM stakeholders.

11.2 Before moving forward with ATFM implementation, the following steps should be taken:

a) establish an accurate picture of the expected traffic demand through the collection, collation and analysis of air traffic data, bearing in mind that it is useful to:

1) monitor aerodromes and airspaces in order to quantify excessive demand and significant changes in:

i) forecast demand; and
ii) ATM system performance targets;

2) obtain varied demand data from different sources, for example:

i) a comparison of recent traffic history (e.g., compare the same day of the previous week or compare seasonal high-demand periods);
ii) traffic trends provided by national authorities, user organizations (e.g., IATA), etc.; and
iii) other related information (e.g., air shows, major sports events, large-scale military manoeuvres); and

b) consider the complexity and cost of these measures in order to ensure optimum performance, not only from a capacity point of view but also from an economic and cost-effective perspective.

11.3 The operational concept establishes a straight-forward implementation strategy. This strategy should be developed in phases and scalable basis, so as to ensure maximum utilization of the available capacity and enable all concerned parties to obtain sufficient experience.

Airports

11.4 The implementation process of ATFM in the CAR/SAM Regions related to airports starts with the establishment of the airport capacity, which enables identification of periods in which demand exceeds capacity. With that identification, traffic management measures can be planned with a view to optimize the utilization of the existing capacity.

11.5 When developing airport slot allocation procedures, capacity allowance for other operations, such as non-regular flights should be kept in mind.

11.6 The evolution of traffic management measures for airports should evolve towards tactical applications and the use of automation tools and efficient and effective communications means with aircraft operators in order to tactically balance air flows, demand and capacity.

Airspace

11.7 Given that the fundamental purpose of ATFM is to be able to balance demand with capacity, it is understood that a realistic implementation is based on the determination of the capacity of the ATS system. The *Manual on Collaborative Air Traffic Flow Management* provides basic guidance for this determination.

11.8 Is unlikely that strategic traffic management measures alone in the airspace will be sufficient to prevent overload of ATC sectors as capacity is not static in nature, but subject to many dynamic events including the impacts of weather events and CNS capabilities.

11.9 If demand and capacity balancing in the airspace cannot be accomplished with existing strategic traffic management measures, States/Territories and International Organizations should move to more effective solutions. This may involve pre-tactical and tactical traffic management measures related to airspace, including dynamic procedures, and ATFM control measures including ground delay programs and airspace flow programs, that are applied to flights scheduled in the near-term. This would require the utilization of automation and infrastructure tools in addition to those applied strategically.

11.10 States/Territories and International Organizations who decide to implement airspace tactical traffic management measures should develop standards and operational procedures where applicable to this service.

12. ATFM Performance and Measurement

12.1 An ATFM service can provide significant business and operational benefits to the ATM community, by delivering flexible operations within defined and agreed sets of rules. The main benefits of ATFM are capacity and efficiency improvements through better usage of resources. The ATFM also brings benefits in the areas of safety, predictability, environment and cost.

12.2 The key to fully realizing these benefits lies in the implementation and application of ATFM services at a system-wide level (e.g., regional, sub-regional and/or global). Furthermore, the adoption of a Performance-Based Approach (PBA) to implement ATFM would ensure that the deployment of ATFM-related capabilities and solutions have measurable benefits on ATM performance.

12.3 Measuring the performance of an ATFM system enables users to identify its contribution to the overall ATM operational environment and understand how performance improves as techniques and technology enable new capabilities. To measure and assess variations of ATFM performance, a baseline performance assessment is needed. It is then used to measure targeted improvements. States must consider activities directed to assess the ATFM performance as of early stages of service implantation.

12.4 The GANP drives the evolution of the global air navigation system to meet the ever growing expectations of the aviation community. The performance ambitions, at a global level, will be met by pursuing more specific performance objectives. In addition to the Doc 9883 – *Manual on Global Performance of the Air Navigation System* and Doc 9971, Part II, GANP portal's Implementation page (https://www.icao.int/airnavigation/Pages/GANP-Resources.aspx) provides information on performance based approach.

12.5 The GANP performance framework is part of the global technical level of the GANP. Its goal is to allow harmonization of air navigation performance measures at regional and national levels. This will allow benchmarking, sharing of lessons learnt regarding the benefits achieved from the implementation of operational improvements within different operating environments, as well as regions and States to set common performance objectives and comparable targets. The performance framework consists of a catalogue of performance objectives, defined in the same 11 key performance areas as the ambitions, and an associated list of KPIs.

12.6 At a regional level, Volume III of the regional Air Navigation Plans provides regional performance objectives according to specific regional requirements. The regional performance objectives assist the aviation community in identifying relevant and timely enhancements (operational improvements) to a given region's air navigation system. And at a national level, States can set performance targets for their different operational environments using the list of KPIs, taking into account regional performance requirements.

12.7 Taking as a reference the series of key performance indicators presented in the GANP, the CAR/SAM Regions have agreed, in principle, to use the following indicators as a basis for regional and national measurement of the performance of ATFM systems:

- KPI01 Departure punctuality. Percentage of flights departing from the gate on-time (compared to schedule);
- KPI03 ATFM slot adherence. Percentage of flights taking off within their assigned ATFM slot (Calculated Take-Off Time Compliance);
- KPI04 Filed flight plan en-route extension. Flight planned en-route distance compared to a reference ideal trajectory distance;
- KPI05 Actual en-route extension. Actual en-route distance flown compared to a reference ideal distance; and
- KPI14 Arrival punctuality. Percentage of flights arriving at the gate on-time (compared to schedule).

12.8 Information related to these KPIs will be expanded in **Appendix E**.

13. Special Flights Exempt from Application of ATFM Measures

13.1 Aircraft that file flight plans as air ambulance flights, humanitarian flights, search and rescue operations, and State aircraft will be exempt from the application of traffic management measures. States will continue to have jurisdiction on these aircraft when they file as domestic flights.

14 Contingency Plan

14.1 In case of a partial or total interruption of the flow management and/or support services, FMUs will have corresponding contingency plans, prepared in accordance with ICAO guidelines. These contingency plans will help ensure the safe and orderly movement of air traffic and will be incorporated into the operational procedures documents associated with the FMU responsibilities.

APPENDIX A

Table

Routing Areas and Main Traffic Flows Identified in the CAR/SAM Regions

-1- Routing Area (AR)	-2- Traffic flows	-3- FIRs involved	-4- Type of area	-5- Remarks
Caribbean/South American Regions (CAR/SAM)				
AR 1	Buenos Aires-Santiago de Chile	Ezeiza, Mendoza, Santiago	Low density Continental	SAM intra-regional traffic flow
	Buenos Aires-Sao Paulo/Río de Janeiro	Ezeiza, Montevideo, Curitiba, Brasilia	Low density Continental	SAM intra regional traffic flow
	Santiago de Chile-Sao Paulo/Rio de Janeiro	Santiago, Mendoza, Córdoba, Resistencia, Asunción, Curitiba, Brasilia	Low density Continental	SAM intra regional traffic flow
	Sao Paulo/Rio de Janeiro-Europe	Brasilia, Recife	Continental / Low density Oceanic	SAM/AFI/EUR inter regional traffic flow
AR 2	Sao Paulo/Río de Janeiro-Miami	Brasilia, Manaus, Maiquetía, Curacao, Kingston, Santo Domingo, Port au Prince, Habana, Miami	Continental / Low density Oceanic	CAR/SAM/NAM inter- and intra-regional traffic flow
	Sao Paulo/Río de Janeiro-New York	Brasilia, Belem, Paramaribo, Georgetown, Piarco, Rochambeau, San Juan (New York)	Continental / Low density Oceanic	CAR/SAM/NAM/ NAT inter- and intra-regional traffic flow

-1- Routing Area (AR)	-2- Traffic flows	-3- FIRs involved	-4- Type of area	-5- Remarks
AR 3	Sao Paulo/Río de Janeiro- Lima	Brasilia, Curitiba, La Paz, Lima	Low density Continental	SAM intra-regional traffic flow
	Sao Paulo/Río de Janeiro- Los Angeles	Brasilia, Porto Velho, Bogotá, Barranquilla, Panamá, Central América, Mérida, México, Mazatlán (Los Angeles)	Low density Continental	CAR/SAM/NAM inter- and intra-regional traffic flow
AR 4	Santiago - Lima - Miami	Santiago, Antofagasta, Lima, Guayaquil, Bogotá, Barranquilla, Panamá, Kingston, Habana, Miami.	Continental / Low density Oceanic	CAR/SAM/NAM inter- and intra-regional traffic flow
	Buenos Aires - New York	Ezeiza, Resistencia, Asunción, La Paz, Porto Velho, Manaus, Maiquetía, Curacao, Santo Domingo, Miami (New York)	Continental / Low density Oceanic	CAR/SAM/NAM/ NAT NAM inter- and intra-regional traffic flow
	Buenos Aires - Miami	Ezeza, Resistencia, Córdoba, La Paz, Porto Velho, Bogotá, Barranquilla, Kingston, Habana, Miami	Continental / Low density Oceanic	CAR/SAM/NAM NAM inter- and intra-regional traffic flow
AR 5	North of South America - Europe	Guayaquil, Bogotá, Maiquetía, Piarco (NAT-EUR)	Continental / high density Oceanic	SAM/NAT/EUR inter-regional traffic flow

-1- Routing Area (AR)	-2- Traffic flows	-3- FIRs involved	-4- Type of area	-5- Remarks
AR 6	Santiago - Lima - Los Angeles	Santiago, Antofagasta Lima, Guayaquil, Central Amérca, México	Low density oceanic	CAR/SAM /NAM intra- and inter-regional traffic flow
AR 7	South America – South Africa	Ezeiza, Montevideo, Brasilia, Johanesburgo (AFI)	Low density oceanic	SAM/AFI inter-regional traffic flow
	Santiago de Chile - Isla de Pascua - Papeete (PAC)	Santiago, Pascua, Tahiti	Low density oceanic	SAM/PAC inter-regional traffic flow
GM-1	Mexico, Toluca, Guadalajara, Monterrey, Mazatlán, La Paz, Acapulco, Puerto Vallarta, Huatulco, Cancún Gulf of Mexico— North America	Mexico, Houston, Miami; Albuquerque; Los Angeles	Continental/oceanic high density	CAR/NAM inter-regional major traffic flow
	Cancún, Guatemala, El Salvador, Nicaragua, Honduras, Costa Rica – Miami	Mexico, Central America, Havana, Miami	Continental/oceanic high density	CAR/NAM interregional traffic flow
GM-2	Mexico, Cancun, La Havana, Nassau — Europe	Mexico, Havana, Miami -NAT-EUR	Continental/oceanic high density Major traffic flow	CAR/NAM/NAT/ EUR inter-regional traffic flow
GM-3	Costa Rica, Panama, Honduras Kingston, Haiti, Santo Domingo San Juan, The Caribbean — Europe	Central America, Panama, Kingston, Port-au-Prince, Curacao, Santo Domingo, San Juan – EUR	Oceanic high density	CAR/ NAT/EUR intra and interregional major traffic flow
	North America – East Caribbean	New York, Miami, Havana, San Juan, Santo Domingo Piarco	Oceanic high density	West Atlantic Route System CAR/NAM inter-regional traffic flow

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APPENDIX B

General Considerations for Collaborative Decision-Making (CDM) process

Note. - Doc. 9971 Part III expands the reach of collaboration and describes how the CDM concept applies to airport operations and aircraft turnaround. Building on the experiences of various States in different regions, and reflecting the scalability needed to ensure efficiency, the manual identifies the roles and responsibilities of actors and stakeholders, and details the methods and tools that can be used in airport collaborative decision-making (A-CDM).

1) According to Doc 9971 Part I, CDM is a process applied to support other activities such as demand/capacity balancing. CDM can be applied across the timeline of activities from strategic planning (e.g., infrastructure investments) to real-time operations. CDM is not an objective but a way to reach the performance objectives of the processes it supports. These performance objectives are expected to be agreed upon collaboratively. Since implementing CDM likely will require investments, these will need to be justified in accordance with the performance-based approach.

2) Although information sharing is an important enabler for CDM, the sharing of information is not sufficient to realize CDM and the objectives of CDM.

3) CDM also requires predefined and agreed upon procedures and rules to ensure that collaborative decisions are made expeditiously and equitably.

4) CDM ensures decisions are taken transparently based on the best information available as provided by the participants in a timely and accurate manner.

5) The development and operation of a CDM process follows these typical phases:

    1) identification of the need for CDM;

    2) CDM analysis;

    3) CDM specification and verification;

    4) CDM performance case;

    5) CDM validation and implementation; and

    6) CDM operation, maintenance and improvement (continuous).

    It is important that the results of all these phases be shared between the involved community members.

6) The first phase is the identification of the need to apply CDM to realize a performance improvement. This can relate to current processes/operations or to future processes. A “need statement” should refer to the process(es) to which CDM should be applied and specify the current situation, involved community members and current (or projected) performance shortfall(s).

7) In the second phase, CDM analysis, the process is further analysed from a decision-making perspective.

8) The analysis should make clear what decisions are to be made, which community members are involved (or affected), which information is used in support of the decision(s), which process(es) are followed, how and through which means the decision-making process can be improved and how such an improvement could contribute to better performance.

9) The third phase, which builds on the CDM analysis, results in a shared and verified specification of the CDM process. It will address:

   a) the decisions to be taken, how they are reached and finalized;

   b) the community members involved and their roles/responsibilities in the decision(s);

   c) agreement on objectives; there may be a shared objective with individual sub-objectives (e.g., resolve congestion while minimizing impact to one's own operation);

   d) decision-making rules, processes and principles including specification of timeline/milestones, interactions, roles and responsibilities;

   e) information requirements including data standards, quality, frequency and deadlines; and

   f) the CDM maintenance process: review, monitoring/verification, etc.

10) The objective of the performance case, developed through the fourth phase, is to justify the decision to implement the CDM process and to make the necessary investments. It should clearly specify the costs involved and describe the benefits that will result from the operation of CDM. It is important that the results of the performance case be shared between all relevant community members. In case the CDM process is an integral part of a new process, it should be integrated in the performance case.

11) The fifth phase, CDM validation and implementation, includes all steps to bring CDM into operation. It includes training and informing staff, implementation/adaptation of systems, information networks, etc.

12) Once the CDM process is operational it should be subject to a continuous and shared review, maintenance and improvement process. In this way, performance can be continually improved.

APPENDIX C

General Considerations for the Implementation Process of a Flow Management Unit

The implementation of a Flow Management Unit should consider the following requirements:

a) Access to the operational status of the air navigation infrastructure.

b) Access to aeronautical information and cartography.

c) Access to meteorological information.

d) Database of:

- aerodromes;
- airport capacity;
- ATC sector capacity
- Air traffic demand
- Airspace structure
- Radio navigation aids
- Aircraft performance; and
- Utilization of airports and control sectors.

e) Access to flight planning data (FPL, RPL, etc.).

f) Flight plan processing.

g) Access to surveillance data (SSR, ADS, etc.)

h) Automated resources:

- Processing and data visualization system for flow management, having, among other thing, the following sub-systems:

  - Flight data processing
  - Airspace and airports structure data;
  - Situation analysis (capacity and demand);
  - Presentation of air traffic situation;
  - Monitoring of the operational status of the infrastructure;
  - Support to collaborative decision making (ATC slots, alternate routes, etc.).
  - Database maintenance.

i) Communication to coordinate with:

- Other FMUs
- Operators (airlines, general aviation, State, etc.);
- Airport management;
- FMUs and/or FMPs and/or ATS units;
- Aeronautical meteorological units;
- AIS units.

j) Human resources

- qualified personnel;
- support personnel;
- recurrent training.

k) Use of adequate tools for statistics

l) Infrastructure

- buildings
- equipment
- electrical power
- air conditioning
- supplies
- software

m) Implementation of FMPs, as required.

n) Redundancy of critical systems.

APPENDIX D
CAR/SAM ATFM/CDM Regional Training Programme
ATFM Training Requirements

Table of Contents

1. Introduction

General

1.1 Air Traffic Flow Management (ATFM) is an enabler of Air Traffic Management (ATM) efficiency and effectiveness contributing to the safety, efficiency, cost effectiveness and environmental sustainability of an ATM system. ATFM aims at enhancing safety by ensuring the delivery of safe densities of traffic and by minimizing traffic surges. Its purpose is to balance traffic demand with available capacity. As traffic grows, an increasing number of States are moving towards the implementation of an ATFM service. Although this is a positive development, it also generates another challenge. Because of its effect on neighbouring airspaces, ATFM needs to be coordinated between States. ATFM systems therefore need to be compatible and interoperable. In this respect, the development of coordinated and harmonized training requirements is a first step in ensuring a harmonized application of ATFM. Once demand starts to reach the levels of available ATC capacity, a functioning ATFM service becomes a vital component of safe and efficient provision of Air Traffic [Control] Services (ATS). Therefore, the personnel staffing the Flow Management Unit (FMU) need to have sufficient knowledge and understanding of the ATM system they are supporting and the potential effects of their work on the safety and efficiency of air navigation. To ensure this and in the frame of their training policy, States and ANSPs should establish training plans to ensure that ATFM service staff are properly trained in order to ensure the availability, continuity, accuracy and integrity levels requested for the service provided.

1.2 ICAO Doc 9971 — *Manual on Collaborative Air Traffic Flow Management (ATFM)* recognizes the requirement for training all stakeholders in an ATFM service, i.e. both those directly operating in the ATFM function and all other ATFM stakeholders including airspace users and ATS personnel (ref. Doc 9971 chapter 7). Due to the complexity of the issues at hand when setting out to balance demand against available capacity, the provision of an efficient ATFM service requires that training is approached in a systematic manner. This document addresses the need to provide a set of training requirements to be introduced in support of a harmonized and effective ATFM operation. The document describes the requirement for training for staff having responsibilities with regard to the ATFM function. It addresses the requirement for the various levels of staff in an ATFM Unit, as well as those stakeholders affected by ATFM measures. The proposed training requirements are designed to support local application of ATFM at the same time as it prepares States for a regional application of ATFM. It is assumed that each State and/or ANSP that will set out to train ATFM service staff will have to consider the type of equipment used in their area of operation. The material in this document is made very general when it comes to training required to operate the system that is used, and will have to be detailed based on the tools used in that particular area in support of ATFM services. ICAO and EUROCONTROL sources were consulted for the development of the training concepts and methodology presented herein. The proposed training syllabus is derived with the support of in-depth ATFM service expertise.

Background

1.3 Regional networked ATFM forms a major part of the ICAO Aviation System Block Upgrade (ASBU) framework since Block 0 (2013) through B0-NOPS. In support of the B0-NOPS module, ICAO enlisted a group of experts from States, ANSPs, and International Organizations with ATFM experience (ATFM Manual Coordination Team) to develop Doc 9971, providing guidance on Collaborative ATFM implementation (published in 2014). Meanwhile, an ATFM Training Programme, including training requirements for each ATFM position and every level of training and objectives (in line with ICAO TRAINAIR Plus Methodology), is now included as an Appendix to the CAR/SAM ATFM Concept of Operations (CONOPS).

Purpose and Scope of this Document

1.4 The purpose of this document is to define a training process and specify training guidelines in order to have a common level of training for staff that operate and/or "experience" ATFM services. In many cases, an individual may already possess the required competence and experience in a particular domain and may not need to follow a formal training course on this subject. Nevertheless a process of confirm the individuals competence should still be followed. The document addresses the following:

- Who is to be trained?
- What pre-requisite skills are required or can be obtained?
- What are the job responsibilities and required competencies?
- What is the required content of ATFM training?
- What is the level of training depending on the level of responsibilities to be exercised?

Structure of This Document

1.5 The ATFM Training Requirement Guidelines consist of 5 Chapters, and 2 Appendices:

- Chapter 1: Introduction
- Chapter 2: ATFM Training Structure
- Chapter 3: From job responsibilities via competencies to training requirements
- Chapter 4: Ab initio ATFM Training
- Chapter 5: Basic training
- Appendix A: Glossary (to be included)
- Appendix B: List of Abbreviations (to be included)

2. ATFM Training Structure

A Model of ATFM Training

2.1 By means of ATFM training, it is expected that staff of an ATFM unit will obtain the appropriate skills to operate and maintain an ATFM function in an appropriate manner and consequently provide harmonized, homogenous and consistent ATFM services in the entire region. In addition to the staff of the FMU itself, there are several other units/areas/entities where staff needs to be aware of ATFM services provided and the specific roles and responsibilities they carry in this process. Units where ATFM is exercised or directly experienced and where staff therefore needs training include:

- ATC
- Aircraft Operators
- Pilots
- Airport Operators
- Military, both service providers and users
- Regulatory bodies

2.2 An ATFM service is provided at different levels, each with its own training requirements. The different levels of ATFM responsibilities considered include the operations management and supervision levels, planning and execution of the service and essential support staff. In addition, there are different support functions, CDM partners and general ATM personnel that need to be considered when developing training requirements.

2.3 This guidance document proposes a six level (taxonomy levels) set of training objectives for each ATFM population grouping depending on the level of responsibility to be exercised by each group.

- Level 0: To be aware of terms, processes, and theory.
- Level 1: A basic knowledge of the subject. It is the ability to remember essential points, to memorize data and retrieve it.
- Level 2: The ability to understand and to discuss the subject matter intelligently in order to represent and act upon certain objects and events.
- Level 3: A thorough knowledge of the subject and the ability to apply it with accuracy. The ability to make use of the repertoire of knowledge to develop plans and activate them.
- Level 4: The ability to establish a line of action within a unit of known applications following the correct chronology and the adequate method to resolve a problem situation. This involves the integration of known applications in a familiar situation.
- Level 5: The ability to analyze new situations in order to elaborate and apply one or other relevant strategy to solve a complex problem. The defining feature is that the situation is qualitatively different to those previously encountered and a solution is attained.

(Source: EUROCONTROL Specification for the ATCO Common Core Content Initial Training)

2.4 This guidance proposes that a matrix should be constructed to determine the level of training and competency required for each group in the ATFM population. A partial matrix template is shown below. This is developed further in the document. The levels are shown for illustrative purposes only.

Group / **Subject**	Operations management	Supervision	Planner	Execution	Support	CDM partner	General ATM personnel
ATM	2	2	2	2	2	1	1
ATFM	2	3	4	3	2	2	1
ATC	2	2	2	1	1	1	1
Airport Operations	2	2	2	2	1	1	1
Aircraft Operations	2	2	2	2	1	1	1
Meteorology	2	2	3	3	2	1	1
ICAO	3	2	2	2	2	1	1
ATFM tools	2	2	3	3	3	2	1
Capacity Assessment	2	2	2	1	1	1	1
Airspace Design	2	2	2	1	1	1	1

Phases of ATFM Training

2.5 General: ATFM training can be divided into a number of phases. This document concentrates on training requirements for Ab initio and Basic Phases, other phases are only discussed briefly.

i. Ab initio Training
Ab initio training is intended to ensure that new ATFM staff possesses the necessary contextual knowledge in order to follow the more detailed job related training. In many cases staff may already possess this knowledge (e.g. ATC staff will possess the necessary ATC knowledge, airline operations personnel the necessary aircraft operations knowledge). The possession of the necessary ab initio subject knowledge should be assessed upon recruitment/assignment. In cases where staff possess the necessary contextual knowledge these staff may be exempted in whole or part from elements of ab initio training.

ii. Basic Training
Basic training is the main phase where the core ATFM and associated operational topics are covered in a comprehensive fashion. Basic training also covers more detailed knowledge of subjects related to ATFM than in ab initio training. At the successful completion of basic training the staff member should have all the relevant knowledge to proceed to on-the-job training before performing his role in the ATFM operation.

iii. On-the-Job (OJT)
ATFM, in common with many other operational occupations requires a substantial amount of practical application of the occupation under appropriate supervision in order to ensure that the acquired knowledge from the basic training course(s) can be applied in an autonomous manner. The purpose is to reinforce formal training and support the achievement of competency standards. If appropriate, OJT phases can also follow advanced or refresher training.

iv. Advanced Training
As ATFM functions develop, a number of advanced ATFM analysis and application techniques are used. Some staff involved in the execution of ATFM will require a higher level of skills and advanced-training modules will be required for both such cases. The purpose of advanced training is to augment the skills and knowledge of ATFM personnel in dealing with either more specific, complex problems or a wider breadth of issues.

v. Recurrent/Refresher Training
It is essential that ATFM personnel update his or her competencies in accordance with the latest operational requirements, and new methodology/technologies applied. Regular recurrent training should therefore be planned. It is important to maintain the current skills of ATFM personnel. Some ATFM techniques are applied only in very rare situations (contingency, exceptional events). ATFM personnel can be absent from their core operational function for extended lengths of time. For these three reasons recurrent/refresher training modules will be required.

Training Requirements for ATFM Instructors

2.6 To ensure efficient training, the trainers have to be in possession of the necessary skills. Apart from a thorough knowledge of the subject to be taught, the trainers also need to demonstrate the ability to convey the knowledge in a pedagogic and structured way. It is recommended that the trainers have attended Classroom Techniques training courses.

2.7 In cases where a State is implementing an ATFM service for the first time, and thereby do not have the expertise needed to perform the training available in their country, different solutions could be considered. In cases where a system is procured to support the application of ATFM, the inclusion of a package for training of the trainers should be considered. For more in-depth knowledge of the procedures and processes involved, it may be necessary to send the staff responsible for the training to attend courses given by trainers having the experience required to train staff on the application of ATFM.

3. From Job Responsibilities Via Competencies To Training Requirements

3.1 General

Introduction

3.1.1 The first steps in the process of designing detailed training requirements are to:

- identify job responsibilities and associated performance and measurement criteria; and
- identify the competencies required to meet these job responsibilities and performance.

3.1.2 With full understanding of job responsibilities, it is possible to determine what the competencies are of a fully competent staff member. Items that may be needed to perform this analysis include:

- The specific job or position description or summary;
- Specific ATFM organization performance requirements or competencies; and
- Standard operating procedures that apply to an individual's position or responsibilities.

3.1.3 When the pre-requisites described above are identified and analyzed, it is possible to design the training required to address the gaps through the development of the learning objectives for each competency that needs to be addressed. Based on the identification of the learning objectives, a curriculum can then be designed.

The Link between ATC and ATFM

3.1.4 Before looking at the details of the job responsibilities of an ATFM Unit, there is a requirement to understand its links with ATC. ATFM is a cross-domain activity, and even if the focus has shifted from the early task of protecting ATC from overload to a more comprehensive demand/capacity balancing activity, there are still very strong links between ATC and an ATFM service.

3.1.5 The ATC Supervisor is accountable for the provision of ATC services for *en route* and TMA operations within the FIRs for which this service is being provided. As part of that responsibility, he/she is normally also accountable for all strategic and tactical ATFM decisions. In a smaller ACC the supervisor may keep that responsibility, but in a larger ACC this is often delegated to an "Airspace Manager", either being the Flow Management Position (FMP) in the ACC or the ATFM Unit (ATFMU) Supervisor.

3.1.6 To be able to make strategic and tactical decisions related to the application of ATFM, there is a requirement for a large measure of ATC knowledge, and when the responsibility to make these decisions is delegated to an FMP and/or FMU Supervisor it normally requires that the staff operating these positions have an ATC background. It is important that the training provided be such that the FMP and/or supervisor of the FMU are able to fully understand and discuss ATC operations so that the expected outcomes can be achieved.

3.1.7 Over time, the objective should be to develop the FMU to become an integral part of ATC so that it is the manager of the airspace, ensuring the delivery of the right amount of demand in the right shape to achieve maximum capacity.

3.2 Tasks and Competencies

Main Tasks for an ATFM Unit

3.2.1 The objective when defining the tasks of an ATFM unit should be to ensure that the FMU become the focus for an effective management of airspace availability and capacity determination. The FMU should manage and coordinate actions associated with optimizing demand against the capacity of the airspace, ensuring that the complexity of traffic does not exceed the capability of the control service.

3.2.2 The FMU should maintain a strategic and tactical overview of the network (airspaces and airports within and adjacent to its area of responsibility), being responsible for the development of tactical ATFM strategies, and for managing network responses to demand and capacity issues.

3.2.3 The main tasks of a service provided by an ATFM unit include:

- receive and analyze all ATFM data and associated parameters;
- determine airport and airspace capacity for next day's operation;
- plan and coordinate ATFM daily plan for the next day's operation;
- manage proper execution of ATFM measures on day of operation based on ATFM daily plan;
- coordinate tactical adjustments on ATM resources with the local ATC Supervisors;
- monitor and execute ATFM measures on day of operation as required based on ATFM daily plan;
- ensure proper integration of traffic demand inputs;
- ensure proper configuration of ATFM automation support systems;
- ensure optimization of resources through an efficient CDM process;
- provide focus and specialist expertise for planning, coordinating and implementing measures for capacity management and contingency operations; and
- conduct post operations analysis of previous days ATFM operation.

Competencies for Staff Executing ATFM

3.2.4 To perform ATFM tasks, staff needs to be trained to possess a number of competencies. They need to have full knowledge of the FIR and/or airports for which the service is applied. They also need to understand the factors that impact the capacities for the various parts of airspace and airports, and they need to be fully aware of the impact on the provision of ATC that the different actions they propose may have. In order to be effective, the FMU needs to coordinate and cooperate closely with ATC, airports and civil and military airspace users.

3.2.5 The required competencies include the ability to:

- determine an accurate picture of air traffic demand;
- receive, verify, evaluate, enter and store all relevant ATFM data;
- monitor the evolution of demand versus capacity; identifying all shortfalls and opportunities for optimization;
- determine the need for ATFM measures in all phases of ATFM;
- draw up and publish ATFM plans and any changes to the plan (understand what information is to be published);
- create, maintain, monitor and adjust all relevant ATFM scenarios and measures;
- ensure that Aircraft operators (AOs) are provided with advice and guidance for minimizing delays and disruption; and
- know and adhere to all relevant operational instructions, operations manuals and letters of agreement (actively locate, read and follow instructions).

3.3 ATFMU Operational Staff Job Descriptions

General

3.3.1 The job descriptions of staff operating an ATFM facility will depend on the chosen organization. For the purposes of this document, the following job descriptions are proposed. Depending on the local organization, responsibilities may be delegated or not, and functions may be combined or subdivided.

- ATFM Unit Operations Manager
- ATFM Unit Supervisor
- ATFM Unit Planner
- ATFM Unit Office (executive)
- ATFMU Support Assistant
- ATFMU CDM partner

ATFM Unit Operations Manager Job Description

3.3.2 Each ATFM unit should have a clearly designated line manager directly responsible for the overall operation of the unit. They are the immediate hierarchical superior of the ATFMU supervisors. Although not normally involved in the direct execution of ATFM, it is recommended that the Operations Manager be subject to an appropriate form of training and competency assessment.

3.3.3 The job description of the Operations Manager is not defined in this document as this will vary according to the organization management structure. However it is strongly recommended that the Operations Manager acquire and maintain level 2 (ability to understand and to discuss the subject matter intelligently in order to represent and act upon certain objects and events) competence in all the subjects contained in the basic training content.

ATFMU Supervisor Staff Job Description

3.3.4 The duties of the supervisor/manager of an ATFM service function include:

- ensure self-briefing and that all ATFM staff are fully briefed on all aspects of the operation;
- plan and coordinate with ATC supervisor capacity adjustment for next day's operation;
- plan and coordinate ATFM daily plan for the next day's operation;
- in coordination with local ATC supervisor, manage local and network resources to optimize capacity and minimize delays within their areas;
- supervise the proper execution of ATFM measures on day of operation based on ATFM daily plan;
- organize, chair and conduct all necessary CDM conferences;
- proactively use their experience and authority in an appropriate manner, be creative and use initiative in the resolution of problems that may arise using an inclusive collaborative process;
- execute all appropriate staff management duties fairly and transparently in accordance with local procedures and processes;
- manage disruption and contingency procedures and ensure appropriate escalation;
- ensure ATFMU management is aware of all significant events; and
- ensure accurate log keeping and recording of all significant occurrences.

ATFMU Planner Staff Job Description

3.3.5 The duties of the planning function of an ATFM service include:

- manage and execute the short term strategic and pre-tactical operational processes and post operational evaluation;
- maintain a good level of coordination with the ATC Supervisor in order to negotiate the best possible pre-tactical solutions including negotiating improved capacity i.e. runway configuration or times to de-combine sectors, applying ATFM regulations where necessary and proposing and implementing the optimum ATFM measures for the network;
- create and continuously adapt plans. Propose new solutions taking into consideration ever changing circumstances;
- proactively provide all reasonable assistance to the airspace users in order to facilitate them to optimize their operations;
- endeavour to maintain the principles of network optimization and collaborative decision making during all ATFM processes;

- coordinate ATFM solutions with other operational functions (tactical, AMC, Flight Planning);
- ensure that the ATFM network plan and all changes are fully communicated with Aircraft Operators, airports and Air Traffic Control Centers; and
- evaluate execution of the ATFM plan in order to determine lessons learned and issues for future attention.

ATFMU Officer Job Description

3.3.6 The duties of the ATFM Officer function of an ATFM service include:

- execute the tactical flow management operational process from a network perspective;
- constantly monitor traffic loads on all ATFM resources;
- monitor any potential and actual changes in capacity (e.g. staffing, weather, airport infrastructure, etc.) and implement appropriate measures;
- maintain a good level of coordination with the ACC/airport in order to negotiate the best possible tactical solutions including negotiating improved capacity, applying measures where necessary and proposing and implementing re-routing scenarios;
- continuously adapt plans. Propose new solutions taking into consideration ever changing circumstances;
- proactively provide all reasonable assistance to the airspace users and air navigation service providers in order to allow them to optimize their operations;
- endeavour to maintain the principles of network optimization and CDM during all relevant ATFM processes;
- coordinate tactical adjustment on ATM resources; and
- ensure the promulgation of all measures taken.

ATFMU Support Assistant Job Description

3.3.7 The duties of the ATFM Support Assistant function of an ATFM service include:

- coordination with external clients (airspace users, ATS units, military) under the supervision of planning and executive staff;
- reception, validation and input of ATFM data;
- ensure proper integration of traffic demand inputs;
- maintenance of operational documentation; and
- responding to routine queries from external clients, providing standard information and referring issues to planner and officer where appropriate.

Note: The duties of the Support Assistant function will depend on which executive position the support function is assigned to. It is suggested that the same basic training curriculum is followed for support and executive staff, but that the level of knowledge and competency required be at a lower level.

CDM Partner Job Description

3.3.8 The duties of CDM Partners are not defined in this document. It is suggested that the training authority selects the appropriate subject and competency levels for each CDM partner group based on the detailed training requirements below.

4. Ab initio ATFM Training

4.1 Ab initio training is intended to ensure that new ATFM staff possesses the necessary contextual knowledge in order to follow the more detailed job related training. In many cases, staff may already possess this knowledge (e.g., ATC staff will possess the necessary ATC knowledge; airline operations personnel the necessary aircraft operations knowledge).

Basic Requirements

4.2 The possession of the necessary ab initio subject knowledge should be assessed upon recruitment/ assignment. In cases where staff possess the necessary contextual knowledge these staff may be exempted in whole or part from elements of ab initio training.

4.3 There are several basic requirements or pre-requisites for the successful conduct of ATFM training. These include:

- Pre-requisite skills and experience (e.g. experience in ATM, aircraft, airport operations)
- Complementary skills (Information Technology skills, written and oral communication skills, operations analysis, statistics experience)
- Medical requirements
- Language requirements

4.4 Normally these competences and requirements form part of the recruitment requirements. The definition of these general requirements is beyond the scope of this document. However, material is readily available in the public domain from other ATM related functions that can assist those responsible for recruitment and training to draw up appropriate general competency and experience requirements.

ATFM Ab initio Training Content

4.5 The subjects contained in the modules below need to be covered in the Ab initio Training phase. It is recommended that the appropriate taxonomy level for ab initio training is between level 1 (basic knowledge) and 2 (understand and discuss).

Level 1: A basic knowledge of the subject. It is the ability to remember essential points, to memorize data and retrieve them.

Level 2: The ability to understand and to discuss the subject matter intelligently in order to represent and act upon certain objects and events.

4.6 ATFM as described by ICAO is a collaborative process between ATC and the airspace user facilitated by the ATFM units. Airport operations authorities are also an essential ATFM partner. It is therefore suggested that these partners should be closely associated with the training content development and delivery. The ab initio training should include facilitated visits of the operations units of these stakeholders.

4.7 The modules that need to be covered during the Ab initio Training Phase can be found at **Attachment A** to this guidance.

5. Basic ATFM training

5.1 Basic training is the main phase where the core ATFM and associated operational topics are covered in a comprehensive fashion. At the successful completion of the class room training, part of the basic training, the staff member should be fully prepared to begin his/her period of OJT in the pre-tactical and/or tactical area. He/she should have achieved all the relevant knowledge and skills and be able to understand the concept of ATFM, the operating procedures in place and the use of related equipment.

5.2 The start of the training should be preceded by an information session providing the training aims and the overall planning for the entire training. As part of the informative session, trainees would be informed about the design of the training modules, and their expected involvement during the training. Depending on the background of the trainees, it may be beneficial to consider involving the participants in a workshop style environment, encouraging them to develop their own ideas and to motivate them into thinking how the role of the ATFMU can be developed to support the overall objectives of the ATFMU.

5.3 The following modules need to be covered during the Basic Training Phase:

1. Foundational objectives and principles of ATFM
2. ATFM Institutional and Regulatory background
3. The CDM Process in the context of ATFM
4. ATM Planning
5. ATFM Phases
6. ATFM Demand
7. ATFM Measures (traffic management Initiatives)
8. ATFM Contingency Procedures
9. ATFM Data and Tools
10. ATFM Systems Thinking, Communications and Conflict Management

5.4 This document does not provide a detailed curriculum for ATFM training since this has to be individually prepared based on the pre-requisites for that particular training course. When deciding on training content for a specific Basic Training course, it is important to consider:

- the position that the trainees are going to be trained for, i.e. the job responsibilities;
- the competencies required to carry out the tasks; and
- the background of the trainees, i.e. the competency level.

5.5 Based on those three criteria and the training requirements they indicate, the content of the modules described at **Attachment B** to this guidance can be adapted to fit the needs of a specific course.

5.6 At **Attachment C** is a description of how one State (xxxx) has organized its training for ATFM positions. The attachment includes a sheet where the details of what needs to be covered during the OJT period is listed; items against which the trainee has to demonstrate an acceptable level of knowledge and understanding.

Attachment A

Modules to be covered during the Ab initio Training Phase

Aviation Law and Institutional Background

Phase	Ab initio	
Subject	Aviation Law and Institutional Background	
Objective	**Understand** the national and international regulatory context of ATM in general and ATFM	
Content:		Reference documents:
International Aviation Structure and Organizations		Chicago Convention, Annex 11, Local legislation and rules, Doc 4444, Doc 9971
National Aviation Structure		
National Aviation Regulations		
Structure of ANS and ATS		
Institutional international and national background of ATFM		
Safety Management Principles		

Air Traffic Management

Phase	Ab initio	
Subject	Air Traffic Management	
Objective	Learners shall **understand** the basic principles of air traffic management and be able to **discuss** basic operational procedures.	
Content:		Reference documents:
Air Traffic Control Service (Aerodrome, Approach, Enroute, Oceanic)		Annex 11, Doc 4444, Doc 9971, Doc 7030, ATFM Manuals introduction Local ASM rules Annex 2, Doc 7910 local rules
Flight Information Service and Advisory service		
Alerting Service		
ATFM Introduction		
Airspace Management		
Altimetry and Level allocation		
Separations		
ATM Data • ICAO designators • Other designators		
Flight Plan processing		

Air Traffic Flow Management

Phase	Ab initio	
Subject	Air Traffic Flow Management	
Objective	Learners shall **understand** the basic principles and origin of ATFM and be able to **discuss** basic operational procedures.	
Content:		Reference documents:
Objectives of ATFM		Doc 9971
Benefits of ATFM		
Principles of ATFM		

Aircraft and Flight Efficiency

Phase	Ab initio
Subject	Aircraft
Objective	Learners shall **understand** the basic principles of the theory of flight and aircraft characteristics and how these influence ATS and ATFM operations.

Content:	Reference documents:
Principles of flight	Local airline Standard Operating Procedures (SOP) Doc 4444, EUROCONTROL ERNIP (flight efficiency section)
Aircraft Engines	
Aircraft Systems and Instruments	
Aircraft Categories	
Factors affecting aircraft performance	
Aircraft performance data	
Flight efficiency concepts (economic, environmental)	

ATM Equipment and Systems

Phase	Ab initio
Subject	ATM Equipment and Systems
Objective	Learners shall understand the basic working principles of equipment that is in general use in ATC

Content:	Reference documents:
Radio communications	Local ATM System Manuals
Radar, primary, secondary, mode S, Controller-Pilot Data Link Communication (CPDLC)	
Automatic Dependent Surveillance (ADS)	
Aeronautical Fixed Telecommunication Network (AFTN), On-Line Data Interchange (OLDI), Air Traffic Services Inter-facility Data Communication (AIDC)	
Abrupt Manoeuver (AMAN), DMAN,ASMGS	

Airport Operations

Phase	Ab initio
Subject	Airport Operations
Objective	Learners shall understand the operations related functions carried out at airports.

Content:	Reference documents:
Aerodrome infrastructure	IATA Slot allocation guidelines Local Airport documentation
Airport capacity	
Airport scheduling, coordination. Airport slot allocation	
Management of maintenance	
Management of disruptive events	

Airline Operations

Phase	Ab initio
Subject	Airline Operations
Objective	Learners shall **understand** the ATM operations related functions carried out by aircraft operators.

Content:	Reference documents:
Airspace Users operating models (hub, point to point, major carriers, low fare sector…)	Local Airline Operations Manuals
The airlines operations Centre	
Airspace Users (scheduled, non-scheduled, business, general aviation, military)	

ATFM and CDM

Phase	Ab initio
Subject	ATFM and CDM
Objective	Learners shall understand the fundamental CDM concepts underlying effective ATFM

Content:	Reference documents:
ATC v ATFM	Doc 9971
ATFM; bridging the gap between ATC and airline operations	
CDM competencies	
CDM skills	

Meteorology

Phase	Ab initio
Subject	Meteorology
Objective	Learners shall **understand** how meteorology affects ATS operations and aircraft performance and limits ATFM capacity.

Content:	Reference documents:
Basic introduction to meteorological phenomena	Local MET Manuals
Aviation meteorological forecasts and observations	
Understand the meteorological hazards to aviation	
Weather and capacity	

Example of a Course Design Guide to be used for Courses in the Ab initio Training Phase

1. TITLE OF THE ACADEMIC PROGRAMME

"Meteorology"

2. GENERAL OBJECTIVE

In accordance with local meteorological manuals, the student will be able to describe how meteorology affects aircraft operations and performance, and limits airport and airspace capacity.

3. GRADUATE PROFILE

Upon the successful completion of this course, as part of a series of courses designed to fulfill the initial training for an ATFM position, the graduate will have the sufficient knowledge to work in an introductory Flow Management Position. The graduate will have the knowledge necessary to collaborate on airport and airspace capacity issues, which involve a weather constraint. This course prepares the graduate to work in conjunction with professionally trained meteorologists, but is not designed to make one an expert in meteorology. Terms and basic theory, however, will be understood. Previous meteorological knowledge obtained in training by an air traffic controller may qualify some individuals to be exempt from this course.

4. SPECIFIC OBJECTIVES

The student will be able to interpret weather prediction tools.
The student will be able to collaborate to determine reduced capacity due to a constraining weather event.
The student will be able to use terms to communicate with local weather service employees and will be able to use their knowledge of air traffic procedures in such collaboration.

5. MODULAR STRUCTURE

MODULES	HOURS		
	Theory	**Practices**	**Total**
1. Basic introduction to meteorological phenomena	3	-	**3**
2. Aviation meteorological forecasts and observations	3	-	**3**
3. Understand the meteorological hazards to aviation	3	-	**3**
4. Weather and Capacity	4	-	**4**

6. METHODOLOGY

Active-participatory method of teaching and learning with expositions of the instructor.
The techniques use will be lecture, reading, independent study, dynamics, group discussions and practice exercises.

7. INSTRUCTION RESOURCES

- Projector
- Flip Charts
- Computers
- Banners

8. INSTRUCTORS

Instructors should be able to adequately administer the lesson plans and should have experience as an air traffic controller with a flow management background.

9. DURATION

13 hours of instruction and reading.

10. EVALUATION CRITERIA

The performance in the realization of exercises and practical activities in the classroom will be evaluated and at the end of the course a practical exam will be realized that will cover the total content allowing thus to measure the achievement of the raised objectives.

Practical Final Exercise: 30%.
Exercises and Practical Activities: 70%.

11. BIBLIOGRAPHY

Attachment B

Modules to be covered during the Basic Training Phase

Foundational Objectives and Principles of ATFM

Phase	Basic
Subject	Foundational objectives and principles of ATFM
Objective	• understand the philosophy of air traffic flow management, including the objectives and principles of ATFM; • know how the ATFM service operates; • know the terms and definitions used; • know the structure and organization of the ATFM service function, including the roles and responsibilities of the stakeholders in the ATFM service; and • understand the training requirements for stakeholders in the ATFM service.

Content:	Reference documents:
Objectives and principles Benefits of ATFM How the ATFM service operates Systems, processes and operational data that supports the application of ATFM Basics of a CDM process Link to Airspace Management (ASM), Civil/Military coordination Organizational structure Roles and responsibilities	• ICAO Doc 4444, • ICAO Doc 9971, • Local ATFM documentation

Role:	Operations Management	Supervision	Planner	Execution	Support	CDM Partner
Level:	2	5	5	4	3	2

ATFM Institutional and Regulatory Background

Phase	Basic
Subject	ATFM Institutional and Regulatory Background
Objective	• know the regulatory background, both global and local, for the application of an ATFM service.

Content:	Reference documents:
Objectives and principles Benefits of ATFM How the ATFM service operates Systems, processes and operational data that supports the application of ATFM Basics of a CDM process Link to ASM, Civil/Military coordination Organizational structure Roles and responsibilities	• ICAO Annex 11 and 15 • Doc 4444 • AIP and other local documentation

Role:	Operations Management	Supervision	Planner	Execution	Support	CDM Partner
Level:	2	5	5	4	3	2

The CDM Process in the Context of ATFM

Phase	Basic
Subject	The CDM Process in the context of ATFM
Objective	• Full knowledge of the process to communicate and exchange operational information among stakeholders on a real-time basis. • Understanding of how the CDM process allows decisions to be taken to best meet the operational requirements of all concerned.

Content:	Reference documents:
CDM organization and structure Support to ATFM stakeholders Communication means Communications in tactical operations; e-conferences, tele-conferences, etc. Stakeholder roles and responsibilities Understanding of the interaction with other stakeholders at the various stages of the process ATFM Operations and airports ATFM Operations and aircraft operations ATFM Operations and meteorology CDM requirements and benefits Link to A-CDM	• Doc 4444 • Doc 9971 • Local ATFM documentation

Role:	Operations Management	Supervision	Planner	Execution	Support	CDM Partner
Level:	2	5	5	4	3	2

ATM Planning

Phase	Basic
Subject	ATM Planning
Objective	• understand the process to optimize available capacity, and how to use other available capacities; • be aware of factors impacting capacity.

Content:	Reference documents:
ATM Planning Quantify imbalance between demand and capacity How to address the imbalance at the strategic phase Capacity assessment models Monitoring values Intervention values ATC Capacity Staffing schedules and opening schemes of the component ATC Units Capacity optimization Factors reducing capacity Coordination with ASM	• Doc 4444 • Doc 9971 • Local ATFM documentation

Role:	Operations Management	Supervision	Planner	Execution	Support	CDM Partner
Level:	2	5	5	4	3	2

ATFM Phases

Phase	Basic					
Subject	ATFM Phases					
Objective	• Understand the main principles for how the ATFM processes are applied during the different phases in order to balance demand and capacity within a given area.					
Content:					Reference documents:	
Strategic Phase Strategic to pre-tactical Pre-tactical Phase Pre-tactical processes Building a pre-tactical plan The concept of a rolling plan Airport role during pre-tactical Aircraft operator role during pre-tactical Special events planning Slot allocation process, including principles, computer assisted or manual allocation process, and change process Tactical Phase Re-routing flights Manual actions on a flight Tactical management of the daily plan Post-Operations Requirements for a good post-operations analysis Feedback and evaluation Operational feedback o Incident reporting					• Doc 4444 • Doc 9971 • Local ATFM documentation	
Role:	Operations Management	Supervision	Planner	Execution	Support	CDM Partner
Level:	2	5	5	4	3	2

ATFM Demand

Phase	Basic	
Subject	ATFM Demand	
Objective	• know the process of organizing demand into traffic volumes based on particular reference locations; • understand the configurations used and the establishment of pre-defined scenarios; • understand how traffic demand, the tactical traffic situation and met forecasts can be used to optimize capacity; and • understand issues related to occupancy.	
Content:		Reference documents:
Establishing demand Establishing demand for a sector/airport Establishing demand along predefined major traffic flows Determining Traffic Volumes based on defined demand Determine reference locations Occupancy counts/duration		• Local ATFM documentation

Define major traffic flows in a traffic volume Implementation and management of predefined scenarios Set up and run simulations Forecasts Schedules and flight plans, including missing flight plans Airport slots Flight positions						
Role:	Operations Management	Supervision	Planner	Execution	Support	CDM Partner
Level:	2	4	5	4	3	2

ATFM Measures

Phase	Basic					
Subject	ATFM Measures (Traffic management Initiatives)					
Objective	• know the different measures available and how to apply them in the ATFM service; • understand the role of the stakeholders in the process.					
Content:					Reference documents:	
Apply, modify and cancel ATFM measures Capacity Optimization measures (sector/airport management, complexity reduction) Demand distribution measures (routing scenarios, level capping, advancing traffic, balancing arrivals/departures, ground delay) Demand regulation/reduction measures (airborne delay/holding, minimum departure intervals, miles in trail, policy, out of area traffic, adherence) Exemptions and exclusions (compliance monitoring, reporting) Slot adherence Slot swapping and slot extensions, policy Delay causes and attribution Use tools to support the processes Compliance monitoring					• Doc 4444 • Doc 9971 • Local ATFM documentation	
Role:	Operations Management	Supervision	Planner	Execution	Support	CDM Partner
Level:	2	5	5	4	3	2

ATFM Contingency procedures

Phase	Basic					
Subject	ATFM Contingency procedures					
Objective	• Full understanding of procedures to be applied in the case of a contingency.					
Content:					Reference documents:	
Contingency procedures Management of industrial actions Non-availability of airspace/airports Adverse weather situations Convective weather Low visibility De-icing conditions					• Local ATFM documentation	
Role:	Operations Management	Supervision	Planner	Execution	Support	CDM Partner
Level:	2	5	3	3	2	1

ATFM Data and Tools

Phase	Basic					
Subject	ATFM Data and Tools					
Objective	• ensure full knowledge of the function and use of tools providing support to the application of ATFM; and • understanding of the need for sharing of data.					
Content:					Reference documents:	
ATFM Support tools Main functionalities of tools used Pre-tactical tools used Building a plan in a pre-tactical tool Environmental data in ATFM support tools Static, semi-static and dynamic data Flight data in ATFM support tools Traffic load monitoring (types of traffic counts) Flight activation monitoring Data exchange and sharing					• Doc 9971 • Local ATFM documentation	
Role:	Operations Management	Supervision	Planner	Execution	Support	CDM Partner
Level:	2	4	5	4	3	1

Example of a Course Design Guide to be used for Courses in the Basic Training Phase

1. TITLE OF THE ACADEMIC PROGRAMME

"Foundational Objectives and Principals of ATFM"

2. GENERAL OBJECTIVE

In accordance with ICAO Doc 4444 and Doc 9971, and local ATFM manuals, the student will be able to describe the structure and organization of the ATFM service, including the roles and responsibilities of the stakeholders.

3. GRADUATE PROFILE

Upon the successful completion of this course, as part of a series of courses designed to fulfill the basic training for an ATFM position, the graduate will have the sufficient knowledge to work in an introductory Flow Management Position. Completion of this series of courses prepares the learner for on-the-job-training. The graduate will have the knowledge necessary to be able to have a knowledgeable conversation about the history, purpose and mission of ATFM. The graduate will be ready to participate in local CDM discussions with stakeholders and will understand that they are a representative of the ATFM organizational structure.

4. SPECIFIC OBJECTIVES

Understand the philosophy of ATFM, including the objectives and principles of ATFM;
know how the ATFM service operates;
know the terms and definitions used;
know the structure and organization of the ATFM service function, including the roles and responsibilities of the stakeholders in the ATFM service; and
understand the training requirements for stakeholders in the ATFM service.

5. MODULAR STRUCTURE

MODULES	HOURS		
	Theory	**Practices**	**Total**
1. ATFM objectives, principals and benefits	3	-	**3**
2. How the ATFM service operates	1	-	**1**
3. Systems, processes and operational data that supports the application of ATFM	2	-	**2**
4. Basics of a CDM process	2		**2**
5. Link to ASM, Civil/Military coordination	1	-	**1**
6. Organizational structure; Roles and Responsibilities	1	2	**3**

6. METHODOLOGY

Active-Participatory Method of Teaching and Learning with expositions of the instructor.
The techniques use will be lecture, reading, independent study, dynamics, group discussions and practice exercises.

7. INSTRUCTION RESOURCES

- Projector.
- Flip Charts.
- Computers.
- Banners.

8. INSTRUCTORS

Instructors should be able to adequately administer the lesson plans and should have experience as an air traffic controller with a flow management background. History of participation in CDM forums is recommended.

9. DURATION

12 hours of instruction and reading.

10. EVALUATION CRITERIA

The performance in the realization of exercises and practical activities in the classroom will be evaluated and at the end of the course a practical exam will be realized that will cover the total content allowing thus to measure the achievement of the raised objectives.

Practical Final Exercise: 30%.
Exercises and Practical Activities: 70%.

11. BIBLIOGRAPHY.

ICAO Doc 4444
ICAO Doc 9971
ICAO and FAA Joint ATFM Basic Training Lesson Plan One
Local ATFM Manuals

Attachment C

Example of ATFM Training for a Flow Management Position (FMP)

PHASE 1 Ab initio

The Air Traffic Flow Management Unit (ATFMU) or [FMU], is the organization of xxx, i.e. Japan Civil Aviation Bureau (JCAB) providing ATFM services to the aircraft flying in xxx FIR. As soon as transferring into flow management, a rookie TMC or ATFM Officer starts initial training for an assistant position. The training course [lecture or classroom or e-learning] includes, but are not limited to:

- Concept of Air Traffic Management
- Organizational structure and regulatory bases of ATMC [Aviation Law and Institutional Background of FMU]
- Outline of ATM services (i.e. ASM, ATFM, Oceanic ATM, and CDM)
- Knowledge and understanding of the present ATM environment (i.e. FIRs, Sectors of ACCs, TMAs, ATS routes, training/restricted areas, navigational aids, operations and performance of aircraft, information processing system/tool/network related to ATM services, communication procedures, etc.)
- Other : Flight Efficiency, Airport Operations, Airline Operations, Meteorology

PHASE 2 BASIC

The [basic] training for ATFM positions is scheduled following the above-mentioned initial [ab initio, or beginning] training. This level of ATFM training consists of two parts: classroom lectures and practical simulator [lab] training.

The ATFM training starts from the classroom lectures and practical simulator [lab] training, as follows:

Day 1: ATFM system and other associated equipment (management and coordination procedures of standard routes and alternative routes) [In-house data and tools use]

Day 2: Capacity value calculation procedures (weather and ATFM) [planning]

Day 3: Monitoring and prediction of traffic volume (flow control procedures) [demand calculation]

Day 4: Algorithm of Expected Departure Clearance Time (EDCT) calculation (handling procedures related to diversions at major airports) [use of other TMMs/TMIs]

Day 5: Cross border ATFM (characteristics of traffic flow and ATC operating procedures in ACC sectors)

Day 6: Specifications of airports/aerodromes and ATC operating procedure (ATM operations plan and CDM) (simulator [lab]: extracting relevant information/lists, setting capacities)

Day 7: Regulations and agreements on ATFM (simulator [lab]: flow management of ACC sectors)

Day 8: In-house operating procedures (simulator [lab]: flow management of MZZZ/MYZZ) [In-house contingency measures and procedures]

Day 9: Recently introduced/amended procedures (simulator [lab]: flow management of international ATS routes) [phases of ATFM]

Day 10: Case studies (final checks)

PHASE 3 OJT

The On-the-Job-Training (OJT) for ATFM positions is scheduled following the basic training. This level of ATFM training consists of working with an instructor and keeping track of allotted hours of working in the actual ATFM environment at a given facility within an FIR. The OJT is phased and standardized. The Flow Management Position (FMP) trainee (or candidate) and the instructors and supervisors are supposed to use "OJT check sheet" so that the trainee can master a required skill for ATFM services systematically. This appendix contains instructions for completing the ATFM OJT check sheet [form].

This form must be used by OJTI Instructors (OJTIs), and supervisory staff to record their observations of the performance and progress of the FMP candidate in training during simulated control problems, OJT instruction, Skill Enhancement Training (SET), and skill-check sessions.

Using the Worksheet: Complete the following items.

Block 1. NAME: Print name.

Block 2. DATE: Enter month, day, year.

Block 3. POSITION(S): Enter Flow management position(s) (FMP) on which training or skill check is being performed.

Block 4. WEATHER: Record description of weather as visual flight rules (VFR), marginal VFR (MVFR), or Instrument Flight Rules (IFR). Check the one box most representative of the session. Conditions that impact training should be noted in Block 12.

Block 5. WORKLOAD: Check description of workload. Check the one box most representative of the session.

Block 6. COMPLEXITY: Check description of complexity of operations. Check the one box most representative of the session. Note any unusual situations or occurrences that impact training in Block 12.

Block 7. HOURS THIS SESSION: Enter actual clock hours and minutes for this session.

Block 8. HOURS or PERCENT THIS POSITION: Enter total clock hours and minutes spent in training on this position. Include this session. As an option, enter percent of allotted hours expended so far for this position.

Block 9. PURPOSE OF REPORT: Check appropriate purpose of report on the form. Check "OJT" for any activity that is counted as part of the assigned training time. Check "Skill Enhancement" if used for SET. Check "Evaluation" if administering a performance skill check or "Certification" if administering a certification skill check. If "Other" is indicated, document the specific use in Block 12.

Block 10. ROUTING: According to facility requirements.

Block 11. PERFORMANCE: Block 11 consists of the performance section. This section contains Critical job elements (CJE), job function categories, and job functions used as a basis for instructing and evaluating the FMP candidate. Users of this form should review the definitions of all job functions and their respective performance indicators in the attached checklist. These descriptions are guidelines to be used by all participants involved in OJT to ensure that what is expected is mutually understood. This checklist is not all-inclusive and is not meant to limit the duties to be reviewed. The job function category titled "Other" is intended for local use and adaptation.

a) OJTIs place a mark in the columns "OBSERVED" or "COMMENT" as follows:
   (1) OBSERVED: A mark in this column indicates that the operation or procedure was observed during the period, but that no significant comments are made.
   (2) COMMENT: A mark in this column indicates that the operation or procedure was observed during the period and is accompanied by a referenced comment in Block 12.

b) The Supervisor who conducts the skill check uses the columns "SATISFACTORY," "NEEDS IMPROVEMENT," and "UNSATISFACTORY." OJTIs do not make marks in these columns since these terms are used to evaluate. The terms are defined as follows:
   (1) SATISFACTORY: A mark in this column indicates that the FMP candidate's observed performance in this session meets expected performance requirements and indicates that the candidate demonstrates the ability to work independently for this performance item. Examples of exemplary performance and specific comments, along with suggestions for improvement, must be stated in Block 12 of the form for each job function indicated.
   (2) NEEDS IMPROVEMENT: A mark in this column indicates that the candidate's observed performance is acceptable at this stage of training, but must improve in order to meet expected performance. Specific comments, along with suggestions or requirements for improvement, must be stated in Block 12 of the form for each job function indicated.
   (3) UNSATISFACTORY: A mark in the column indicates that the candidate's observed performance is unsatisfactory at this stage of training. Suggestions and recommendations for correcting each unsatisfactory job function must be stated in Block 12, except at the 100 percent level of hours used.

c) To certify on a skill check, all applicable items must be marked satisfactory or "N/O" (Not Observed). If an item is marked "N/O", Block 12 must indicate that the candidate has demonstrated satisfactory performance/knowledge for that job function. If necessary, verbal questioning, simulation, or other methods may be used to demonstrate knowledge of a job function when not observed. (Any mark in the "UNSATISFACTORY" column constitutes a failure of the skill check or certification and must be documented in Block 12.)

d) If a job function is not applicable to a position being observed, it must be recorded as "N/A" (Not Applicable).

Block 12. COMMENTS: Used by the OJTI or by the Supervisor who conducted the skill check, the comment block provides space for the documentation of the candidate's performance during OJT instruction or skill check sessions.

a) OJTI's Use of the Comment Block: This block is used by the OJTI to document an observation when a mark is made in the "Comment" column on the front of the form. The OJTI must sign and date this block. The comments:
   (1) May be specific or general.
   (2) May include exemplary, noteworthy, or unusual events.
   (3) Must describe any observed performance deficiencies. In the case of performance deficiencies, or when improvement is needed in a specific area, references must be made to applicable procedures, Letters of Agreement (LoA), orders/directives, etc.

b) Supervisor's Use of the Comment Block: This block must be used by the Supervisor who conducted the skill check to:
   (1) Document performance/progress.
   (2) Describe performance rated as "Needs Improvement" or "Unsatisfactory" and list references to specific procedures, LoAs, or directives that should be reviewed by the FMP candidate so that the performance problem may be corrected.
   (3) Recommend one of the following:
      (a) Continuation of OJT
      (b) SET
      (c) Suspension of training
      (d) Certification

The Supervisor must sign and date this block.

Block 13. EMPLOYEE'S COMMENTS: This block may be used by the FMP candidate for making comments pertaining to the training period or skill check, or for making general comments regarding training. Sign and date. A signature does not necessarily indicate concurrence with the report, only that the report has been discussed with the candidate.

Block 14. CERTIFICATION: This block is used by the Supervisor to document position certification/recertification. Record position of operation, sign, and date.

Flow Management Position (FMP) OJT Instruction/Evaluation Report

Flow Management Position OJT Instruction / Evaluation Report										
1. Name		Date		3. Position(s)						
4. Weather ☐ VFR ☐ MVFR ☐ IFR		5. Workload ☐ Light ☐ Moderate ☐ Heavy	6. Complexity ☐ Routine Not Difficult ☐ Occasionally Difficult ☐ Mostly Difficult ☐ Very Difficult		7. Hours this Session 8. Hours (%) This Position					
9. Purpose ☐ OJT ☐ CERTIFICATION ☐ ☐ EVALUATION ☐ RECERTIFICATION ☐					10. Routing					
11.	Critical Job Element (CJE)	Job Function Category	Job Function		Observed	Comment	Satisfactory	Needs Improvement	Unsatisfactory
Performance	Operating Methods and Procedures	A. Effective Judgement	1. Awareness is maintained						
			2. Good judgement is applied						
			3. Aware of controller and system user requirements						
			4. Handles unusual situations						
		B. Methods and Procedures	5. Monitors system						
			6. Programmes/initiatives/measures are implemented correctly						
			7. Efficient traffic flow is maintained						
			8. Takes prompt action to correct deficiencies						
			9. Data is handled correctly						
		C. Equipment	10. Equipment capabilities are fully used						
			11. Equipment malfunctions recognized						
			12. Computer entries are complete/correct						
	Communication	D. Communication / Coordination	13. Required coordination is performed						
			14. Coordination is thorough, clear, and concise						
			15. Cooperative, professional manner is maintained						
			16. Relief briefings are complete and accurate						
		E. Other							

Flow Management Position (FMP) OJT Instruction/Evaluation Report (continued)

12. Comments

Signature: _____ Date: _____

13. Employee's Comments:

This report has been
discussed with me (Signature): _____ Date: _____

14. Certification:
I certify that this employee meets qualification requirements for position and is capable of working under general supervision.

Signature of Certifier: _____ Date: _____

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Appendix E

Regionally Agreed ATFM Key Performance Indicators

KPI01 Departure punctuality

Definition: Percentage of flights departing from the gate on-time (compared to schedule).

Measurement Units: % of scheduled flights

Operations Measured: IFR departures of scheduled airlines

Variants:

- Variant 1A – % of departures within ± 5 minutes of scheduled time of departure
- Variant 1B – % of departures delayed ≤ 5 minutes versus schedule
- Variant 2A – % of departures within ± 15 minutes of scheduled time of departure
- Variant 2B – % of departures delayed ≤ 15 minutes versus schedule

Objects Characterized: The KPI is typically computed for traffic flows, individual airports, or clusters of airports (selection/grouping based on size and/or geography).

Utility of the KPI: This is an airspace user and passenger focused KPI. Departure punctuality gives an overall indication of the service quality experienced by passengers, and the ability of the airlines to execute their schedule at a given departure location.

Parameters: On-time threshold (maximum positive or negative deviation from scheduled departure time) which defines whether a flight is counted as on-time or not.

Recommended values: 5 minutes and 15 minutes.

Data Requirement: For each departing scheduled flight:

- Scheduled time of departure (STD) or Scheduled off-block time (SOBT)
- Actual off-block time (AOBT)

Data Feed Providers: Schedule database(s), airports, airlines and/or ANSPs

Formula/Algorithm: At the level of individual flights:

1. Exclude non-scheduled departures
2. Categorize each scheduled departure as on-time or not

At aggregated level:

3. Compute the KPI: number of on-time departures divided by total number of scheduled departures

References & Examples of Use:

- Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016)
- China / Europe benchmarking study (CAUC - EUROCONTROL, 2017)

KPI03 ATFM slot adherence

Definition: Percentage of flights taking off within their assigned ATFM slot (Calculated Take-Off Time Compliance).

Measurement Units: % of flights subject to flow restrictions

Operations Measured: The take-off of IFR flights subject to flow restrictions.

Variants: Variants are possible depending on the size of the ATFM slot window.

Objects Characterized: The KPI is typically computed for individual airports, or clusters of airports (selection/grouping based on size and/or geography).

Utility of the KPI: This KPI gives an indication of the capability of an airport to contribute to ATFM effectiveness by delivering outbound traffic in a predictable manner to the departure runway, in compliance with assigned ATFM slots.

Parameters: Size of the ATFM slot window.
- Variant 1: the period between 5 minutes before and 10 minutes after the CTOT.
- Variant 2: the period between 5 minutes before and 5 minutes after the CTOT.

Data Requirement: For each departing IFR flight subject to an ATFM regulation:
- Calculated Take-Off Time (CTOT)
- Actual take-off time (ATOT)

Data Feed Providers: Airports, ATFM service

Formula / Algorithm: At the level of individual flights:
1. Exclude flights not subject to an ATFM regulation
2. Categorize each departing flight as compliant with its ATFM slot window or not

At aggregated level:
3. Compute the KPI: number of compliant departures divided by total number of departing flights subject to an ATFM regulation

References & Examples of Use
- PRC Performance Review Report (EUROCONTROL 2017)
- European ANS Performance Data Portal
- Slot Tolerance Window (STW) compliance (Single European Sky Performance Scheme)
- EDCT Window compliance (US)
- CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI04 Filed flight plan en-route extension

Definition: Flight planned en-route distance compared to a reference ideal trajectory distance.

Measurement Units: % excess distance

Operations Measured: The planned en-route distance, as selected during the preparation of flight plans.

Variants:
- Variant 1, using a 40 NM cylinder around the departure and destination airport as the start/end of en-route airspace.
- Variant 2, using a 40 NM cylinder around the departure airport and a 100 NM cylinder around the destination airport as the start/end of en-route airspace.

Objects Characterized: The KPI can be computed for any volume of en-route airspace; this implies that it can be computed at State level (covering the FIRs of a State).

Utility of the KPI: This KPI measures the en-route horizontal flight (in)efficiency contained in a set of filed flight plans crossing an airspace volume. Its value is influenced by route network design, route & airspace availability, airspace user choice (e.g. to ensure safety, to minimize cost and to take into account wind and weather) and airspace user constraints (e.g. overflight permits, aircraft limitations). A significant gap between this KPI and the Actual en-Route Extension KPI indicates that many flights are not flown along the planned route, which should trigger an analysis of why this is happening.

Parameters:

A '*Measured area'* is defined for which the KPI is computed. For example, a State.
A '*Reference area*' is defined as a (sub)regional boundary considered, containing all '*Measured areas'*, for example States within the same ICAO Region.
Departure terminal area proxy: a cylinder with 40 NM radius around the departure airport.

Destination terminal area proxy: a cylinder with 40 NM radius around the destination airport (variant 1). For variant 2 the radius is 100 NM.

Data Requirement: For each flight plan:

- Departure airport (Point A)
- Destination airport (Point B)
- Entry point in the 'Reference area' (Point O)
- Exit point from the 'Reference area' (Point D)
- Entry points in the 'Measured areas' (Points N)
- Exit points from the 'Measured areas' (Points X)
- Planned distance for each NX portion of the flight

Data Feed Providers: ANSPs

Formula / Algorithm: For the horizontal trajectory of each flight, different parts (trajectory portions) are considered (see Figure 1 for the example of a flight departing outside the 'Reference Area' and overflying a measured State; Figure 2 for the example of a domestic flight within a measured State):

1. The part of the flight which is within the reference area (segment OD). If airports A and/or B are located within the reference area, the points O and/or D are placed on the airport reference point (ARP).
2. The part of the flight for which the State level indicator is computed (between points N and X). If points A and/or B (the airports) are located within the measured State, the points N and/or X are placed on the 40 NM circle (variant 1) around the airport reference point as shown in Figure 2, to exclude terminal route efficiency from the indicator.

Between points N and X, three quantities can be computed: the planned distance (length of flight plan trajectory), the local direct distance (great circle distance between N and X, not required for this indicator), and the contribution of the trajectory between N and X to the completion of the great circle distance between O and D. This contribution is called the "achieved distance". The formula for computing this is based on four great circle distances interconnecting the points O, N, X and D: achieved distance = [(OX-ON)+(DN-DX)]/2.

When a given flight traverses multiple States, the sum of the planned distance in each State equals the total planned distance from O to D. Likewise the sum of all achieved distances equals the direct distance from O to D.

The extra distance for a portion NX of a given flight is the difference between the actual/flight planned distance and the achieved distance. The total extra distance observed within a measured area (e.g. a State) over a given time period is the sum of the planned distances across all traversing flights, minus the sum of the achieved distances across all traversing flights.

The KPI is computed as the total extra distance divided by total achieved distance, expressed as a percentage.

References & Examples of Use:

- ICAO EUR Doc 030 EUR Region Performance Framework Document (July 2013)
- Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016)
- PRC Performance Review Report (EUROCONTROL 2017)
- European ANS Performance Data Portal
- Single European Sky Performance Scheme

- CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

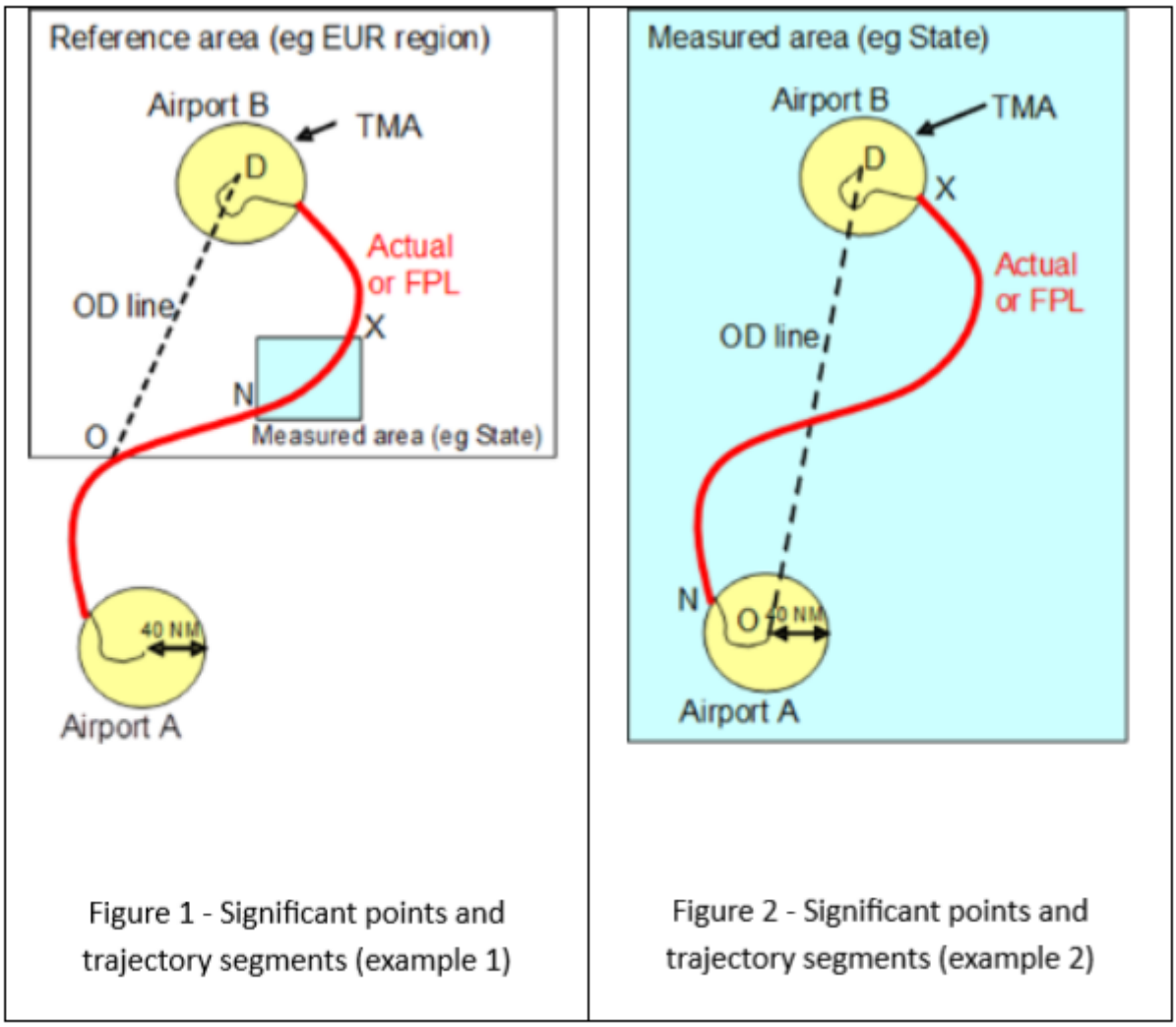

Figure 1 - Significant points and trajectory segments (example 1)

Figure 2 - Significant points and trajectory segments (example 2)

Significant points and trajectory segments (examples 1 and 2)

KPI05 Actual en-route extension

Definition: Actual en-route distance flown compared to a reference ideal distance.
Measurement Units: % excess distance
Operations Measured: The actual distance flown by flights in en-route airspace.
Variants:

- Variant 1, using a 40 NM cylinder around the departure and destination airport as the start/end of en-route airspace.
- Variant 2, using a 40 NM cylinder around the departure airport and a 100 NM cylinder around the destination airport as the start/end of en-route airspace.

Objects Characterized: The KPI can be computed for a traffic flow or a volume of en-route airspace; this implies that it can be computed at State level (covering the FIRs of a State).

Utility of the KPI: This KPI measures the en-route horizontal flight (in)efficiency as actually flown, of a set of IFR flights crossing an airspace volume. Its value is influenced by route network design, route & airspace availability, airspace user choice (e.g. to ensure safety, to minimize cost and to take into account wind and weather) and airspace user constraints (e.g. overflight permits, aircraft limitations), and tactical ATC interventions modifying the trajectory (e.g. reroutings and 'direct to' clearances). The KPI is also typically used to estimate the excess fuel consumption and associated emissions (for the Environment KPA) attributed to horizontal flight inefficiency.

Parameters: Identical to the parameters of the 'Filed Flight Plan en-Route Extension' KPI.

Data Requirement: For each actual flight trajectory:

- Departure airport (Point A)
- Destination airport (Point B)
- Entry point in the 'Reference Area' (Point O)
- Exit point from the 'Reference Area' (Point D)
- Entry points in the 'Measured Areas' (Points N)
- Exit points from the 'Measured Areas' (Point X)
- Distance flown for each NX portion of the actual flight trajectory, derived from surveillance data (radar, ADS-B…).

Data Feed Providers: ANSPs, ADS-B data providers

Formula / Algorithm: Identical to the formula/algorithm of the 'Filed Flight Plan en-Route Extension' KPI.

References & Examples of Use

- ICAO EUR Doc 030 EUR Region Performance Framework Document (July 2013)
- Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016)
- PRC Performance Review Report (EUROCONTROL 2017)
- European ANS Performance Data Portal
- Single European Sky Performance Scheme
- CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

KPI14 Arrival punctuality

Definition: Percentage of flights arriving at the gate on-time (compared to schedule)

Measurement Units: % of scheduled flights

Operations Measured: IFR arrivals of scheduled airlines

Variants:

- Variant 1A – % of arrivals within ± 5 minutes of scheduled time of arrival
- Variant 1B – % of arrivals delayed ≤ 5 minutes versus schedule
- Variant 2A – % of arrivals within ± 15 minutes of scheduled time of arrival
- Variant 2B – % of arrivals delayed ≤ 15 minutes versus schedule

Objects Characterized: The KPI is typically computed for traffic flows, individual airports, or clusters of airports (selection/grouping based on size and/or geography).

Utility of the KPI: This is an airspace user and passenger focused KPI: arrival punctuality gives an overall indication of the service quality experienced by passengers, and the ability of the airlines to execute their schedule at a given destination.

Parameters: On-time threshold (maximum positive or negative deviation from scheduled arrival time) which defines whether a flight is counted as on-time or not.

Recommended values: 5 minutes and 15 minutes.

Data Requirement: For each arriving scheduled flight:

- Scheduled time of arrival (STA) or Scheduled in-block time (SIBT)
- Actual in-block time (AIBT)

Data Feed Providers: Schedule database(s), airports, airlines and/or ANSPs

Formula / Algorithm: At the level of individual flights:

1. Exclude non-scheduled arrivals
2. Categorize each scheduled arrival as on-time or not

At aggregated level:

3. Compute the KPI: number of on-time arrivals divided by total number of scheduled arrivals

References & Examples of Use:

- Comparison of ATM-Related Operational Performance: U.S./Europe (September 2016)
- China / Europe benchmarking study (CAUC - EUROCONTROL, 2017)
- PRC Performance Review Report (EUROCONTROL 2017)