



Agenda Item 2: Implementation of the Air Traffic Flow Management (ATFM) and Collaborative Decision-Making (CDM)

Draft proposal on Second Part of ICAO Doc. 9971

(Presented by the Secretariat)

SUMMARY	
This working paper has the intention to analyze Headquarters' draft proposal on the Second Part of Doc 9971 referring to the ATFM Manual and make, if deemed appropriate, pertinent considerations for its optimization.	
REFERENCE:	
Doc. 9971 - Manual on Collaborative Air Traffic Flow Management	
ICAO strategic objectives:	<i>A - Safety. B - Air navigation capacity and efficiency E - Environmental protection</i>

1 General information

1.1 This working paper presents a draft being made available by Headquarters to experts, in order to make comments intended to its improvement.

1.2 This draft should become a complementary part, as Part II of ICAO Doc 9971, referring to Air Traffic Flow Management in a collaborative form. The Manual contains information on how ATFM should be implemented and applied by using collaborative decision-making processes, in order to balance capacity and demand within different volumes of airspace and airport environments.

2. Analysis

2.1 This material, which is included as **Appendix A** to this working paper, highlights the need of close cooperation among different stakeholders by providing flexibility in the use of the airspace and airport resources.

2.2 In such sense, this guidance material addresses issues related to air navigation service providers, airspace users, airline operation centers, airport operators, airport ground handlers, airport slot coordinators, regulators, military and security authorities, as well as meteorological agencies and industries related to aviation.

3. **Suggested action:**

3.1 The Meeting is invited to analyze the enclosed material and make the comments as deemed appropriate, referring to the corresponding paragraphs in the proposed Manual for easy reference.

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APPENDIX A

Doc 9971

PART II

AIR TRAFFIC FLOW MANAGEMENT (ATFM)

DRAFT

FOREWORD

This guidance material contains information on how air traffic flow management (ATFM) should be implemented and applied by using collaborative decision-making (CDM) processes in order to balance capacity and demand within different volumes of airspace and airport environments. It highlights the need of close cooperation among different stakeholders by providing flexibility in the use of the airspace and airport resources. It provides therefore guidance applicable to:

- a) air navigation service providers;
- b) airspace users;
- c) airline operation centers;
- d) airport operators;
- e) airport ground handlers;
- f) airport slot coordinators;
- g) regulators;
- h) military authorities;
- i) security authorities;
- j) meteorological agencies; and
- k) industries related to aviation.

Key objectives of this guidance material are to:

- a) establish globally consistent ATFM planning and operating practices;
- b) encourage a collaborative and harmonized approach to ATFM between States and regions; and
- c) encourage a systemic approach to ATFM, including all ATM community members.

This guidance material is designed to provide answers to the following questions:

- a) What is the starting point regarding the development of an ATFM service? (Chapter 1);
- b) What are the foundational objectives and principles of ATFM? (Chapter 1);
- c) What are the benefits of implementing an ATFM service? (Chapter 1);
- d) How does an ATFM service operate? (Chapter 2);
- e) How is an ATFM service structured and organized? (Chapter 3);
- f) What are the roles and responsibilities of the stakeholders in the ATFM service? (Chapter 3);
- g) How is the capacity of an airspace sector and airport determined? (Chapter 4);
- h) How are ATFM processes applied in order to balance the demand and capacity within its area of responsibility? (Chapter 4);
- i) How is an ATFM service implemented? (Chapter 5);
- j) What are ATFM Measures and how are they established and applied? (Chapter 6);
- k) What data and information are exchanged in an ATFM service? (Chapter 7);
- l) What terminology/phraseology is used in ATFM? (Chapter 8); and
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GLOSSARY

ABBREVIATIONS/ACRONYMS

AAR	Airport acceptance rate
ADP	ATFM daily plan
A-CDM	Airport-CDM
AIM	Aeronautical information management
ANM	ATFM notification message
ANSP	Air navigation service provider
AO	Aircraft operator
AOBT	Actual off-block time
ASM	Airspace management
ATFM	Air traffic flow management
ATFMU	Air traffic flow management unit
ATFCM	Air traffic flow and capacity management
ATM	Air traffic management
ATOT	Actual take-off time
ATS	Air traffic services
AU	Airspace user
CDM	Collaborative decision-making
CEF	Capacity enhancement function
CFMU	Central flow management unit
CGNA	Air navigation management centre
CTA	Calculated time of arrival
CTO	Calculated times over
CTOT	Calculated take-off time
EOBT	Estimated off-block time
ETA	Estimated time of arrival
ETD	Estimated time of departure
ETO	Estimated time over a reference point
ETOT	Estimated take-off time
FAP	Future ATM profile
FMP	Flow management position
FMU	Flow management unit
GDP	Ground delay programme
GS	Ground stop
IATA	International Air Transport Association
IFR	Instrument flight rules
MDI	Minimum departure interval
NAVAIDs	Navigation aids
MIT	Miles-in-trail
R&D	Research and development
TMA	Terminal control area
ToD	Top of descent
VFR	Visual flight rules
VMC	Visual meteorological condition

REFERENCES

Global Air Traffic Management Operational Concept (Doc 9854) Manual
on Air Traffic Management System Requirements (Doc 9882) Manual on
Global Performance of the Air Navigation System (Doc 9883)
Manual on Flight and Flow – Information for a Collaborative Environment (Doc 9965)
Civil/Military Cooperation in Air Traffic Management (Cir 330-AN/189)
Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444)

Chapter 1

INTRODUCTION

1.1 Air traffic flow management philosophy

1.1.1 Air traffic flow management (ATFM) is an enabler of air traffic management (ATM) efficiency and effectiveness. It contributes to the safety, efficiency, cost effectiveness, and environmental sustainability of an ATM system. It is also a major enabler of global interoperability of the air transport industry and it is important to recognize that, over time, two associated concepts will take shape:

- a) standardized ATFM processes will be implemented globally; and
- b) global ATFM will take shape.

1.1.2 What is the starting point regarding the development of an ATFM service?

1.1.2.1 The level of an ATFM service required in a given setting will depend on a number of factors that will be addressed in this manual. It is important to note that an ATFM service may be simple or complex, depending on the environment and its requirements. Even relatively simple ATFM services, when properly designed and implemented, can be as effective as complex services and thus enable Air Navigation Service Providers (ANSPs) to effectively provide the required service.

1.1.2.2 One key to the successful implementation of an effective ATFM service is achieving a robust coordination among aviation stakeholders. It is envisioned that ATFM is performed as a collaborative decision-making process where airports, ANSPs, Airspace Users (AU), military entities, and other stakeholders work together to improve the overall performance of the ATM system. It is likewise envisioned that such coordination will take place within a Flight Information Region (FIR), between FIRs, and ultimately, between regions.

Note – For the purpose of this guidance the term airspace user includes, but is not limited to, airline, air taxi, charter, general aviation, and military operators.

1.1.2.3 ATFM and its applications may not be restricted to one State or FIR because of their far-reaching effects on the flow of traffic elsewhere. The *Procedures for Air Navigation Service – Air Traffic Management* (PANS-ATM, Doc 4444) recognises this important fact, stating that ATFM should be implemented on the basis of a regional air navigation agreement or, when appropriate, as a multilateral agreement.

1.2 Air traffic flow management objectives and principles

1.2.1 What are the foundational objectives and principles of ATFM?

1.2.1.1 The objectives of ATFM are to:

- a) enhance the safety of the ATM system by ensuring the delivery of safe traffic densities and minimizing traffic surges;
- b) ensure an optimum flow of air traffic throughout all phases of the operation of a flight by balancing demand and capacity;
- c) facilitate 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 attainment of the business or mission objectives of Airspace Users (AUs) and provides optimum operational choices;

- d) balance the legitimate, but sometimes conflicting, requirements of all AUs, thus promoting equitable treatment;
- e) consider ATM system resource constraints and economic and environmental priorities;
- f) facilitate, by means of collaboration among 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) facilitate the achievement of a seamless and harmonised ATM system while ensuring compatibility with international developments.

1.2.1.2 The principles of ATFM are to:

- a) optimize available airport and airspace capacity without compromising safety;
- b) maximize operational benefits and global efficiency while maintaining agreed safety levels;
- c) promote timely and effective coordination with all affected parties;
- d) foster international collaboration leading to an optimal, seamless ATM environment;
- e) recognize that airspace is a common resource for all users and ensure equity and transparency, while taking into account security and defence needs;
- f) support the introduction of new technologies and procedures that enhance system capacity and efficiency;
- g) enhance system predictability and help to maximise aviation economic efficiencies and returns, and support other economic sectors such as business, tourism and cargo; and
- h) evolve constantly to support an ever-changing aviation environment.

1.3 Air traffic flow management benefits

1.3.1 What are the benefits of implementing an ATFM service?

1.3.1.1 The benefits of ATFM lie in various domains of the ATM system:

- a) operational:
 - 1) enhanced ATM system safety;
 - 2) increased system operational efficiency and predictability through collaborative decision-making processes;
 - 3) effective management of capacity and demand through data analysis and planning;
 - 4) increased situational awareness among stakeholders and a coordinated, collaborative development and execution of operational plans;
 - 5) reduced fuel burn and operating costs; and
 - 6) effective management of irregular operations and effective mitigation of system constraints and consequences of unforeseen events;
- b) societal:

- 1) improved quality of air travel;
- 2) increased economic development through efficient and cost-effective services to the projected increased levels of air traffic;
- 3) reduction of aviation-related greenhouse gas emissions; and
- 4) mitigation of the effects of unforeseen events and situations of reduced capacity and effective, rapid recovery from them.

Chapter 2

THE ATFM SERVICE

2.1 How does an ATFM service operate?

2.1.1 ATFM is relevant to any ATM stakeholder when that stakeholder's effect on aviation is viewed from a systemic perspective.

2.1.2 The guiding principles of "first come, first served" and "equitable access to airspace" have traditionally been very important to the ATM system. The global ATM system is evolving, however, to consider net results in terms of overall system efficiency, the environment, and operating costs. To support this evolution, ATFM service may focus on other priorities such as "most capable aircraft" in order to achieve optimum ATM system performance. Likewise, equitable access to airspace may be viewed on a longer time scale than the short term "first come, first served" model.

2.1.3 ATFM service relies on a number of supporting systems, processes and operational data in order to function effectively. The maturity level of these systems and processes will determine the level of ATFM service that is established. Some elements to be considered are:

- a) ATM resources: ATFM recognizes that airspace and aerodromes are common resources shared by all AUs and that equity and transparency must be maintained to the highest standard;
- b) traffic demand: A timely, accurate depiction of predicted flight activity for all flights utilizing an ATM resource (e.g., airport, en route sector, etc.). Data should be aggregated from all operational data sources; e.g., airline schedules, flight plan data, airport slot management systems, ATM operational systems, and AU intentions;
- c) the tactical, dynamic traffic situation: Accurate data derived from surveillance and flight information, to increase the accuracy of short to medium term prediction;
- d) The forecast and dynamic meteorological situation: The integration and display of a variety of meteorological data for ATFM planning and operational execution;
- e) the status and availability of airspaces under restrictions or reservations as it affects the flow of air traffic;
- f) shared ATFM tools and data interoperability: Tools that enable common situational awareness through the sharing of data and operational information among stakeholders. ATFM tools draw from a variety of databases to accurately display meteorological and air traffic information; and
- g) institutional arrangements: Formalized agreements between all ATFM stakeholders in the relevant area and appropriate arrangements with adjacent ATFM units.

2.1.4 Whenever measures to control the flow of air traffic have to be applied in the form of delays, AUs should be notified by ATC while the aircraft are on the ground rather than in flight. A strategy to safely and efficiently balance ground and airborne delays shall be collaboratively agreed upon between the ATFM units, affected ATS facilities and AUs in advance.

2.1.5 AUs should be informed as early as possible regarding the nature and location of ATM constraints so that information can be integrated into the operational plan of the flight.

2.1.6 In addition to airborne holding, the management of airborne delays can be accomplished by slowing aircraft well before top of descent (ToD) and making use of required time of arrival (RTA) aircraft capabilities in order to reduce operating costs, environmental impact, and ATC workload.

2.1.7 When ATFM measures are necessary to manage a constraint, they should be applied in a timely manner and only for the period when expected air traffic demand will exceed the capacity in the constrained area. ATFM measures should be kept to the minimum and, whenever possible, be applied selectively only to that part of the system that is constrained.

2.1.8 Information on anticipated overload situations should be provided to affected AUs as soon as possible.

2.1.9 ATFM measures should be established and coordinated in such a way as to avoid, if at all possible, having cumulative or contradictory effects on the same flights.

2.1.10 Automated tools should be implemented and utilized to allow for effective collaboration and dissemination of ATFM information.

2.1.11 CDM should be utilized to manage flows of traffic through all components of the ATM system. CDM should also occur within and between regions where significant traffic flows exist and interact with each other.

2.1.12 The most efficient utilization of available airspace and airport capacity can be achieved only if all relevant elements of the ATM system have been considered during the planning stage. Moreover, ATFM planning should, whenever required, focus on regional ATFM and be prioritized for appropriate major traffic flows.

2.1.13 ATFM traffic data analysis can yield significant strategic benefits, especially when used in conjunction with airspace and ATS route planning, in terms of future ATM systems and procedure improvements. This is part of a continuous safety and service improvement loop (see Figure 1).

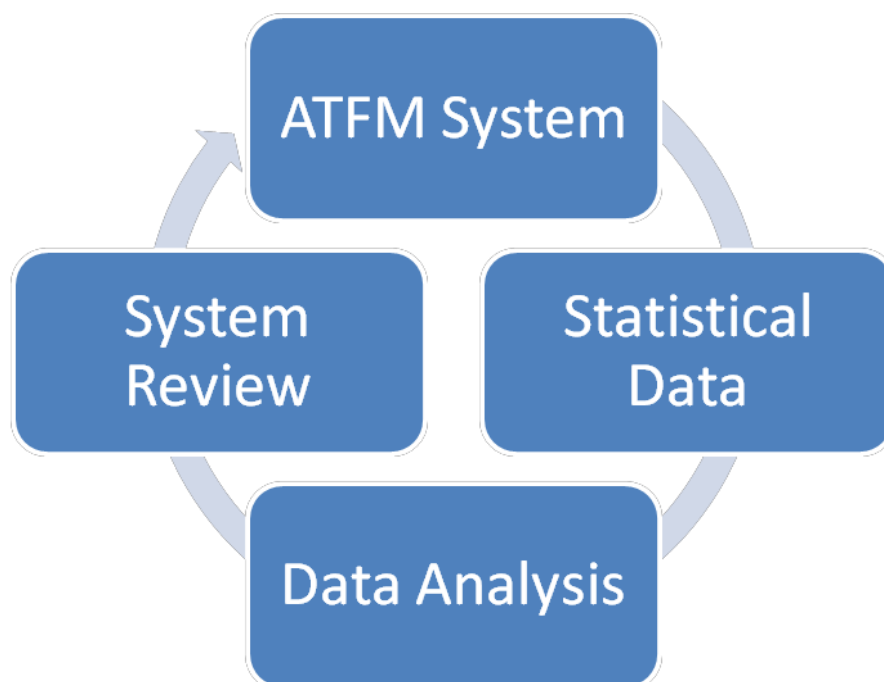


Figure 1. ATFM cycle of review and improvement

2.1.14 States may choose to prioritize or exempt certain classes of flight from ATFM control measures. Examples of such flights include but are not limited to:

- a) flights experiencing an emergency, including aircraft subjected to unlawful interference;
- b) flights on search and rescue or fire-fighting missions;

- c) urgent medical evacuation flights specifically declared by medical authorities;
- d) flights with 'Head of State' status; and
- e) other flights as specifically required by State authorities.

Note – After medical flights have completed their mission they should be subject to ATFM measures. Scheduled passenger transfer flights are, by their nature, non-urgent and should not be given priority under normal operational situation. Notwithstanding any exemption from ATFM measures, exempted aircraft are included in the airport/airspace demand estimation.

2.1.15 Appropriate automated tools could be used to enable and enhance the effective application of ATFM.

2.2 Collaborative decision-making (CDM) in the context of ATFM

2.2.1 CDM is the process which allows decisions to be taken by amalgamating all pertinent and accurate sources of information, ensuring that the data best reflects the situation as known, and ensuring that all concerned stakeholders are given the opportunity to influence the decision. This in turn enables decisions to best meet the operational requirements of all concerned.

2.2.2 The CDM process is a key enabler of an ATFM strategy allowing the sharing of all relevant information between the parties involved in making decisions and supporting an on-going dialogue between the various stakeholders throughout all phases of flight. This enables the various organisations to update each other continuously on events from the strategic level to real-time.

2.2.3 CDM is a supporting process applied to activities such as airspace management and demand/capacity balancing and can be applied across the timeline of activities from strategic planning to tactical operations. CDM is not an objective in itself, but rather a way to reach the performance objectives of the processes it supports. These performance objectives are expected to be agreed upon collaboratively.

2.2.4 Although information sharing is an important enabler for CDM, the sharing of information is not sufficient to realize CDM and the objectives of CDM. Successful CDM also requires agreed upon procedures and rules to ensure that collaborative decisions will be made expeditiously and fairly.

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

2.3 CDM Organization and Structure

2.3.1 The organization and structure of the CDM process depends on the complexity of the ATFM system in place. The structure must be designed to ensure that the affected stakeholders, service providers and airspace users alike, can discuss airspace, capacity and demand issues through regular sessions and formulate plans that consider all pertinent aspects and points of view.

2.3.2 Frequent tactical briefings and conferences can be used to provide an overview of the current ATM situation, discuss any issues and provide an outlook of operations for the coming period. These briefings should be scheduled depending on the traffic patterns and their intensity applicable to the area. They should occur at least daily but may also be scheduled to occur more frequently depending on the traffic and capacity situation (e.g. an evolving meteorological event may require that the briefing frequency be increased). Participants should include involved ATFM and ATS units, chief or senior dispatchers, affected military authorities and airport authorities, as applicable.

2.3.3 The output of these daily conferences should be the publication of an ATFM daily plan (ADP) and subsequent updates. The ADP should be a proposed set of tactical ATFM measures (e.g. activation of routing scenarios, miles-in-trail, etc.) prepared by the ATFM unit and agreed to between all partners

concerned during the planning phase. The ADP should evolve through the day and be periodically updated and published.

2.3.4 Feedback and review of the ADP received from ANSPs, AUs, and from the ATFM unit itself represent very important input for further improvement of the Pre-Tactical planning. This feedback helps the ATFM unit identify the reason(s) for ATFM measures and determine corrective actions to avoid reoccurrence. Systematic feed-back from AUs should be gathered via specifically established links.

2.3.5 In addition to the daily conferences, the ATFM unit should consider holding periodic and event specific CDM conferences, with an agenda based on experience. The objective should be to make sure that ATFM measures to be applied are decided through a CDM process and agreed to by all affected stakeholders.

2.4 CDM Requirements and Benefits

2.4.1 Through the application of a transparent CDM process, the involved stakeholders will gain the necessary situational awareness and ensure that the optimum measures are applied in any given situation. CDM will also create an environment where stakeholders better understand the issues of all concerned.

2.4.2 Regular CDM conferences provide stakeholders with the opportunity to propose enhancements that could benefit them, to follow up on any issue, and to monitor the equity of the flow management process.

2.5 ATFM, CDM, and Civil/Military Coordination

2.5.1 ATFM principles are equally applicable to both civil and military flights operated in accordance with civil rules. Civil/military coordination will provide more flexibility to AUs, thanks to the greater availability of both information and airspace. There will continue to be a need to accommodate missions that are incompatible with civil aviation. These missions may be military operations, support of security requirements, live weapons firing, space operations or others. The degree of civil/military coordination in terms of air traffic management within each State continues to be a matter of national policy and, therefore, military participation in a regulated aeronautical information infrastructure will be subject to national considerations.

2.5.2 The processes aiming to a flexible use of airspace involves an optimum sharing of airspace under appropriate civil/military coordination to achieve the proper separation between civil and military flights, thus reducing the need for permanent airspace segregation.

2.5.3 Benefits of civil/military coordination include:

- a) operational savings for flights through distance, time and fuel reductions;
- b) route network optimization for the provision of ATS and the associated sectoring, providing ATC capacity increases and a reduction of delays of air traffic in general;
- c) more efficient air traffic flow separation procedures;
- a) reduced ATC workload through a reduction in congestion and choke points;
- e) real-time provision of capacity according to the AUs operational requirements; and
- f) definition and use of temporary reservation of airspace more in keeping with operational military requirements, in a way that responds optimally to their specific requirements.

2.5.4 It is recommended that States and/or service providers develop and document a collaborative process with users of airspace under restrictions or reservations that enables the use of these airspaces by civilian traffic when not in active use by the primary user in order to increase efficiency.

2.5.5 When applicable, such agreements and procedures should ideally be established on the basis of a regional air navigation agreement. The agreements and procedures aiming to a flexible use of airspace should specify, inter alia:

- a) the horizontal and vertical limits of the airspace concerned;
- b) the classification of any airspace made available for use by civil air traffic;
- c) units or authorities responsible for the airspace;
- d) conditions for transfer of the airspace to/from the ATS unit concerned;
- e) periods of availability of the airspace;
- f) any limitations on the use of the airspace concerned;
- g) the means and timing of an airspace activation warning if not permanently active; and
- h) any other relevant procedures or information.

Chapter 3

ATFM STRUCTURE AND ORGANIZATION

3.1 How is an ATFM service structured and organized?

3.1.1 It is understood that different levels of ATFM oversight will exist. The main concept, however, is for each State to assign responsibility for the collection, dissemination, monitoring, and surveillance of ATFM activities within its respective FIR(s). This will ensure that all stakeholders have timely and efficient access to applicable ATFM information.

3.1.2 Each State will ensure that an ATFM organizational structure that meets the needs of the aviation community is developed. This structure should address, at a minimum, management and oversight of the following:

- a) the air traffic flow management service;
- b) coordination/exchange of information, both internally and externally;
- c) a line of authority for the implementation of decisions; and
- d) compliance with mission requirements.

3.1.3 A line of authority to support the ATFM service is required. This may include the following:

- a) manager of the ATFM service;
- b) the flow management unit (FMU) that provides ATFM service for a specific set of ATS units; and
- c) flow management positions (FMPs) at specific ATS units responsible for the day-to-day ATFM activities.

3.1.4 A prototype ATFM service could be designed as follows:

- a) an aerodrome control tower can be served by an FMP. This duty can be assigned to an existing position or it may require a dedicated position. The control tower FMP coordinates with the FMP at the approach control unit;
- b) an approach control unit can be served by an FMP. This duty can be assigned to an existing position in the approach control unit or it may require one or more dedicated positions, depending on workload. The approach control unit FMP coordinates with the FMP at an area control centre (ACC);
- c) an ACC can be served by a FMU. This ATFM structure in an ACC is more complex and may consist of a number of traffic management coordinator positions to meet the needs of the ACC and its subordinate units. The following functions at an ACC FMU may require dedicated staff, depending on workload:
 - 1) approach control coordination;
 - 2) departure control coordination;
 - 3) en route coordination;
 - 4) meteorological briefing/forecasting coordination;
 - 5) airspace user liaison;
 - 6) military liaison;
 - 7) airport coordination; and
 - 8) additional support functions, such as administrative and information technology coordination may be required. The additional functions of crisis management

coordinator and post-operations analyst may also be required, as applicable.

- d) a series of ACCs can be served by a national or sub-regional ATFM centre. This is one of the most complex ATFM structures and includes multiple functions. Each function may require dedicated staff or it may be combined, depending on workload. The functions may include:
 - 1) traffic management coordination;
 - 2) traffic planning;
 - 3) meteorological briefing/forecasting coordination;
 - 4) NOTAM/messaging coordination;
 - 5) flight calibration / flight check coordination;
 - 6) airspace user liaison;
 - 7) military liaison;
 - 8) information technology coordination and operational data management;
 - 9) technical operations coordination (concerning infrastructure and systems such as NAVAIDs, radar, VHF communication sites, etc.);
 - 10) crisis management coordination; and
 - 11) operations analysis.
- f) the national or sub-regional ATFM centre is responsible for dissemination and coordination among facilities within its respective area of responsibility and for national, intra-region and inter-regional coordination; and
- g) depending on traffic density and size of the ACC units, some of the functions above may be combined.

3.1.5 The purpose of this coordination methodology is to establish a protocol for each level of the organization to be informed of ATFM information in a timely and accurate manner. This is a generic organizational model that can be modified to meet the needs of each specific environment.

3.1.6 It is desirable that letters of agreement (LOA) or other appropriate documentation be developed in order to attain the necessary standardization.

3.2 Roles and responsibilities of the stakeholders in an ATFM service

3.2.1 What are the roles and responsibilities of the stakeholders in an ATFM service?

3.2.1.1 Flow management unit (FMU)/flow management position (FMP)

3.2.1.1.1 FMUs/FMPs monitor and balance traffic flows within their areas of responsibility in accordance with air traffic management directives. FMUs/FMPs direct traffic flows and implement approved traffic management measures in conjunction with, or as directed by, the oversight authority. FMU/FMP duties may include:

- a) creating and distributing the ATFM daily plan (ADP) based on prior consultation with the designated facilities and stakeholders;
- b) collecting all relevant information, such as meteorological conditions, capacity constraints, infrastructure outages, runway closures, automated system outages, and procedural changes that affect ATS units. This may be accomplished through various means available, such as teleconferences, e-mail, internet, automated data gathering, etc.;
- c) analysing and distribute all relevant information;
- d) documenting a complete description of all ATFM measures (for example, ground delay programmes, miles-in-trail) in a designated log, which must include, among other data, the times of start and end, the affected stakeholders and flights, and the justification;

- e) coordinating procedures with the affected stakeholders;
- f) creating a structure for dissemination of information; for example, a website;
- g) conducting daily telephone and/or web conferences, as required; and
- h) continuously monitoring the ATM system, make service delivery adjustments where necessary, manage ATFM measures and cancel them when no longer required.

3.2.1.2 Airspace users

3.1.2.2.1 The AU participates in the ATFM process by providing and updating flight plan information as well as participating in CDM processes (e.g., discussion of ATFM strategies to improve flight efficiency and participation in user driven prioritisation processes). The participation of AUs in the ATFM process will be supported by CDM telephone conferences and/or web-based interfaces.

3.3 Training requirements for the stakeholders in an ATFM service

3.3.1 FMU/FMP personnel

3.3.1.1 Personnel performing ATFM functions will require standardized and recurrent training in order to maintain currency in a constantly changing environment. A detailed ATFM training plan will ensure that personnel attain an optimized operational efficiency in their respective FMU/FMP. This will allow them to successfully face the important changes in their operational environments and provide the highest possible level of service.

3.3.2 Other ATFM stakeholders

3.3.2.1 All stakeholders involved in the ATFM system must be given the training required to allow for an efficient ATFM service. ATS personnel, as well as AUs, must have the knowledge required to carry out their respective responsibilities.

Chapter 4

CAPACITY, DEMAND AND ATFM PHASES

4.1 How is the capacity of an airspace sector and airport determined?

4.1.1 The capacity of an ATM system depends on many factors, including traffic density and complexity, the ATS route structure, the capabilities of the aircraft using the airspace, weather-related factors, and controller equipment and workload. Every effort should be made to provide sufficient capacity to cater for both normal and peak traffic levels; however, in taking any actions to increase capacity, the responsible ATS authority shall ensure that safety levels are not jeopardized.

4.1.2 The number of aircraft provided with an air traffic service shall not exceed that which can be safely handled by the ATS unit concerned under the prevailing circumstances. In order to define the maximum number of flights which can be safely managed, the appropriate ATS authority should assess and declare the ATC capacity for control sectors (en route and terminal control area) and for airports.

4.1.3 ATC capacity should be expressed as the maximum number of aircraft that can be accepted over a given period of time at an ATM resource (airspace sector, waypoint, airport, etc.). Examples include the sustainable hourly traffic flow or the flow by 15-minute increments.

4.1.4 ATC capacities are not static values. They vary with traffic complexity and other factors. Consideration should be given to tolerance thresholds around standard capacity values that may vary in either direction.

4.1.5 Capacity measurement and calculation methodologies should be developed according to the requirements and conditions of their operational environment. Calculation methodologies have already been established by States in various ICAO regions and they have different levels of complexity. Examples are provided in Appendices C, D and E.

4.2 Balancing demand and capacity

4.2.1 How are ATFM processes applied in order to balance the demand and capacity within its area of responsibility?

4.2.1.1 In order to minimise the effects of ATM system constraints, a methodology to balance demand and capacity should be developed. This can be accomplished through the application of an “ATFM Planning and Management” process. This is a collaborative, interactive capacity and airspace planning process, where airport operators, ANSPs, AUs, military authorities, and other stakeholders work together to improve the performance of the ATM system (see Figure 2).

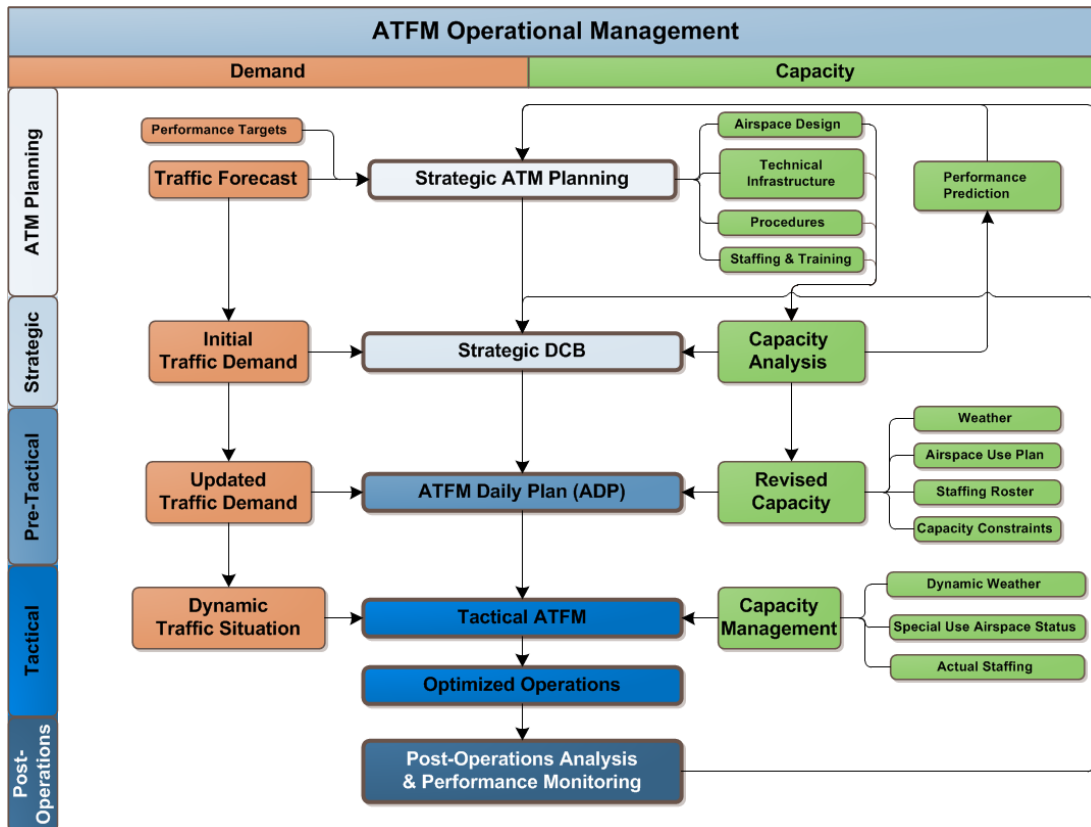


Figure 2. ATFM Operational Management

4.2.1.2 This CDM process allows AUs to optimize their participation in the ATM system while mitigating the impact of constraints on airspace and airport capacity. This also allows for the full realisation of the benefits of improved integration of airspace design, airspace management (ASM), and ATFM. The process contains three equally important phases: ATM Planning, ATFM Execution, and Post-Operations Analysis.

ATM Planning

4.2.1.3 In order to optimise ATM system performance in the ATM Planning phase, available capacity is established and then compared to the forecasted demand and to the established performance targets. Measures taken in this step include:

- reviewing airspace design (route structure and ATS sectors) and airspace utilisation policies to look for improvements;
- reviewing the technical infrastructure to assess the possibility of improving capacity through upgrading various ATM support tools;
- reviewing and updating ATM procedures as required by changes to airspace design and technical infrastructure;
- reviewing staffing practices to evaluate potential for matching staffing resources with workload and the eventual need for an increase in staffing levels; and
- reviewing the training that has been developed and delivered to ATFM stakeholders.

4.2.1.4 Such analysis will provide an idea of the magnitude of a possible imbalance between demand and capacity and based on the imbalance, mitigating measures may need to be developed. However, before this is done, it is very important to:

a) establish an accurate picture of the expected traffic demand through the collection, collation, and analysis of air traffic data.

- In order to identify a demand excess, airports and airspaces should be monitored in order to identify significant changes in:
 - forecast demand;
 - ATM system performance targets;
- Demand data can be obtained from different sources, such as:
 - Comparison of recent traffic history (e.g., comparing the same day of the previous week or comparing seasonal high-demand periods);
 - Traffic trends provided by national authorities, user organizations (e.g., IATA), etc.; and
 - Other related information (e.g., air shows, major sports events, large scale military manoeuvres).

b) take into account 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 perspective.

4.2.1.5 The analysis made and the measures taken will result in a declared ATC capacity, and only in those cases where demand exceeds the declared capacity should there be a requirement to consider the utilisation of ATFM measures in the next phase, ATFM execution.

ATFM Execution

4.2.1.6 ATFM execution, consists of three phases: Strategic, Pre-tactical, and Tactical. These phases should not be considered as discrete steps, but rather as a continuous plan, act and review cycle that is fully integrated with the ATM planning and post operations processes. It is important that operational stakeholders are fully involved in each phase.

Strategic

4.2.1.6.1 The ATFM strategic phase encompasses measures taken more than one day prior to the day of operation and much of this work is accomplished two months or more in advance.

4.2.1.6.1.1 This phase applies the outcomes of the ATM Planning activities. It takes advantage of the increased dialog between AUs and capacity providers, such as ANSPs and airports, in order to analyse airspace, airport and ATS restrictions, seasonal meteorological condition changes and significant meteorological phenomena. It also seeks to identify, as soon as possible, any discrepancies between demand and capacity in order to jointly define possible solutions with the least impact on traffic flows. These solutions are not to be frozen in time, but may be adjusted according to the demand foreseen in this phase.

4.2.1.6.1.2 The strategic phase includes:

- a) a continuous data collection and interpretation process with a systematic and regular review of procedures and measures;
- b) a process to review available capacity; and
- c) if imbalances are identified, take the necessary steps to maximize and optimize all available capacity to adequately cope with projected demand and achieve performance targets.

4.2.1.6.1.3 The main output of this phase is the creation of a list of hypotheses, some of which are disseminated in aeronautical information publications that, through capacity forecasts, allow planners to find

solutions for problematic areas while improving support to ATFM by anticipating the solution to possible traffic configurations.

Pre-Tactical

4.2.1.7 The ATFM pre-tactical phase encompasses measures taken one day prior to the operation.

4.2.1.7.1 This phase studies the demand for the day of the operation, compares it with the predicted available capacity on that day, and makes any necessary adjustments to the plan that was developed during the Strategic phase.

4.2.1.7.2 The main objective of the pre-tactical phase is to optimize capacity through an effective organization of resources (e.g., sector configuration management, use of alternate flight procedures, etc.).

4.2.1.7.3 The work methodology is based on a CDM process between the stakeholders (e.g., FMU, airspace managers, AUs).

4.2.1.7.4 The final result of this phase is an ATFM plan (i.e. ADP) that describes the necessary capacity resources and the measures still pending for managing the traffic. This activity uses hypotheses developed in the Strategic phase and adjusts them to the expected situation. The time limits of the activity are related to the precision of the forecasts and to the capabilities of the different stakeholders.

4.2.1.7.5 The ADP must be developed collaboratively and seeks to optimize efficiency of the ATM system and balance demand and capacity. The objective is to develop strategic and tactical outlooks for the applicable airspace or airport that can be used by stakeholders as a planning forecast.

4.2.1.7.6 It is recommended that, as a minimum, the ADP cover a 24-hour period. The plan may cover a shorter period provided that mechanisms are in place to update the plan on a regular basis.

4.2.1.7.7 The flight intentions of AUs should be consistent with the ADP developed during the strategic phase and with the adjustments made during the pre-tactical phase.

4.2.1.7.8 Once the process has been completed, the agreed measures, including ATFM measures, should be disseminated through an ATFM message, which may be distributed through the various aeronautical communication networks or other means such as internet, email, etc.

4.2.1.7.9 The tasks to be performed during this phase may include the following:

- a) determine the capacity available in the various areas, based on the particular situation that day;
- b) determine or estimate the demand;
- c) conduct a comparative demand/capacity analysis;
- d) study the airspace/airports that are expected to be saturated, flows affected, calculating the acceptance rates to be applied according to system capacity;
- e) prepare a summary of ATFM measures to be proposed and submit them to the ATFM community for collaborative analysis and discussion; and
- f) at an agreed-upon number of hours before the operation, conduct a last review in consultation with the affected ATS units and other stakeholders in order to determine the ATFM measures which will be published through the corresponding ATFM messaging system.

Tactical

4.2.1.8 During the ATFM tactical phase, measures are adopted on the day of the operation. Tactical management of traffic flows and capacity involves considering, in real time, those events that affect the plan and making the necessary modifications to it.

4.2.1.8.1 The tactical phase is aimed at ensuring that:

- a) the measures taken during the strategic and pre-tactical phases solve the demand/capacity imbalances in the flows or areas of application;
- b) the measures taken are the minimum required, and that unnecessary measures are avoided;
- c) the existing capacity is maximized without jeopardizing safety; and
- d) the measures are applied with due regard to equity and overall system optimization.

4.2.1.8.2 This phase seeks to minimize disturbances and take advantage of any opportunities that may arise. The need to adjust the original plan may result from staffing problems, significant meteorological phenomena, crises and special events, unexpected opportunities or limitations related to ground or air infrastructure, more precise flight plan data, the revision of capacity values, etc.

4.2.1.8.3 The provision of accurate information is of vital importance in this phase, since it permits short-term forecasts, including the impact of any event. There are different types of solutions that may be applied, depending on whether the aircraft are already airborne or about to depart.

4.2.1.8.4 Proactive planning and management requires the use of all the information available in forecasts. It is of vital importance to regularly assess the impact of ATFM measures and to adjust them, as much as possible, based on the information received from the various units that constitutes the system.

Post Operations Analysis

4.2.1.9 The final step in the ATFM planning and management process is the post-operations analysis phase.

4.2.1.9.1 During the post-operations analysis phase, an analytical process is carried out that measures, investigates and reports on operational processes and activities throughout all domains and external units relevant to an ATFM service. This process enables the development of best practices and/or lessons learnt for improving upon those operational processes and activities.

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

4.2.1.9.2 While most of the post-operations analysis process may be carried out internally within the ATFM unit, there is a requirement for close coordination and collaboration with external stakeholders in order to optimize the output of the analysis process. By including ATFM stakeholders in the feedback process, collaboration fosters a more efficient and reliable way to achieve optimum results.

4.2.1.9.3 The post-operations analysis should be accomplished by evaluating, along with other items, the ATFM daily plan. Issues reported should be evaluated and analysed in order to learn from the actions reported and make appropriate adjustments and improvements in the future.

4.2.1.9.4 The post-operations analysis includes analysis of items such as anticipated and unanticipated events, ATFM measures and delays, the use of predefined scenarios, flight planning and airspace data issues. It compares the anticipated outcome (where assessed) with the actual measured outcome, generally in terms of delay and route extension, while taking into account performance targets.

4.2.1.9.5 All stakeholders within the ATFM service should provide feedback, preferably in a standardized electronic format, enabling information to be used in the post-operations analysis in an

automated manner.

4.2.1.9.6 In complex areas, and in order to support the post-operations analysis process, an automated replay support tool, including graphical display, is recommended.

4.2.1.9.7 Post-operations analysis may be used to:

- a) identify operational trends or opportunities for improvement;
- b) further investigate the cause and effect relationship of ATFM measures to assist in the selection and development of future actions and strategies;
- c) gather additional information with the goal of optimizing ATM system efficiency, or relating to ongoing events;
- d) perform analysis of specific areas of interest, such as irregular operations, special events, or the use of reroute proposals; and
- e) make recommendations on how to optimize ATM system performance while applying the minimum measures necessary.

4.2.1.9.8 It is important to ensure that applicable ATFM stakeholders be made aware of the results. The following process is recommended:

- a) collection and assessment of data including comparison with targets;
- b) broad review and further information gathering at a daily briefing;
- c) weekly operations management meeting to assess result and recommend procedural, training and system changes where necessary to improve performance; and
- d) periodic operations review meetings with stakeholders.

Figure 3 below provides an overview of the post-operations analysis cycle.

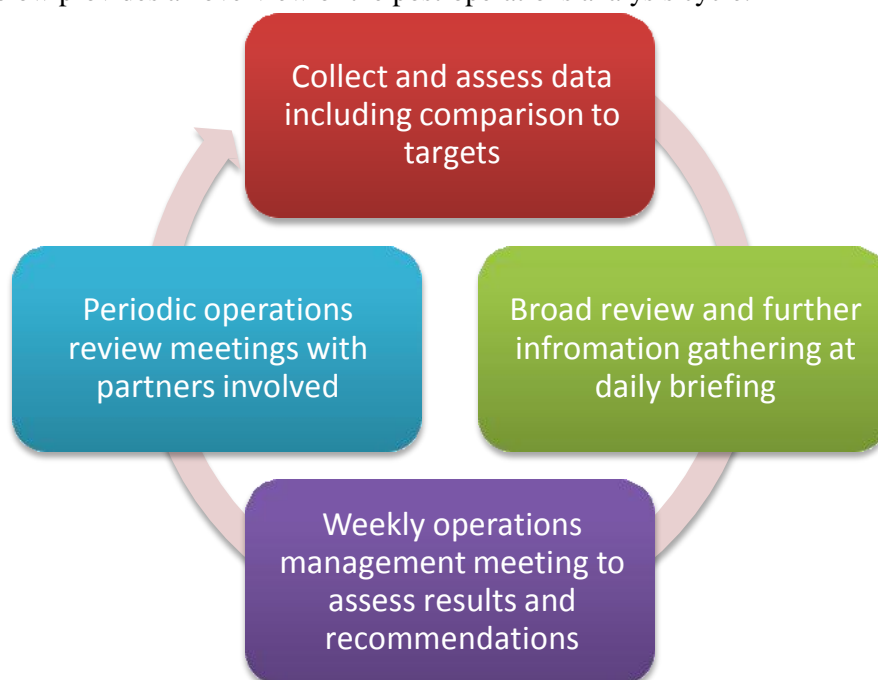


Figure 3. The Cycle of Post-Operations Analysis

ATFM IMPLEMENTATION

5.1 How is an ATFM service implemented?

5.1.1 The ATFM implementation strategy should be developed in phases in order to ensure maximum utilization of the available capacity and enable all concerned parties to obtain sufficient experience. In order to maximize the use of all resources available, whether in terms of personnel, equipment, facilities and/or automated systems, the ATFM service should be planned, developed and implemented in stages.

5.1.2 The experience acquired in other regions and by some States permits ANSPs to apply basic ATFM procedures without the immediate need for a national or sub-regional ATFM Centre. While a number of sub-regional ATFM Centres already exists, the development of new sub-regional ATFM Centres will require additional study.

5.1.3 Over time, and in order to maximize the operational efficiency of airspaces and airports, consideration should be given to the establishment of Regional ATFM Centres to oversee subregional ATFM Centres in the provision of the ATFM service. If there are no sub-regional ATFM Centres, the Regional ATFM Centre would oversee the national ATFM units or the ATFM service provided by the ACCs.

5.1.4 It is also important that the procedures applied during the implementation process be developed in a harmonious manner among the various States to avoid risks to operational safety and efficiency. This entails establishing a national, sub-regional, and regional strategy to facilitate and harmonize the implementation process

5.1.5 In its initial applications, ATFM need not to involve complex procedures or sophisticated tools. The goal is to collaborate with system stakeholders and communicate operational information to AUs, ANSPs, and other stakeholders in a timely manner.

5.1.6 In the initial applications, this can be accomplished via point-to-point telephone calls designed to exchange pertinent meteorological information, system constraints, and other information of operational significance. Examples include relaying information on known runway closures, equipment maintenance, staffing constraints, volcanic activity, and reroute information. Significant benefits can be realized by applying such an initial level of ATFM service.

5.1.7 ATFM development: Initial steps

5.1.7.1 The following initial steps provide guidance concerning the development of an ATFM service:

- a) establish the objectives, project management plan, and oversight of ATFM;
- b) identify the personnel who will lead the development of ATFM;
- c) identify and brief the stakeholders;
- d) define the ATFM structure that will be established;
- e) consider the facilities and equipment that will need to be procured for the implementation of ATFM;
- f) develop or adopt and apply a model for establishing the Airport Acceptance Rate (AAR) at the appropriate airports;
- g) develop or adopt and apply a model for establishing en route sector and terminal sector capacity;

- h) identify the appropriate locations for FMUs and FMPs;
- i) identify the personnel and operational phone numbers that will serve as the point of contact for ATFM issues at each stakeholder location. For example:
 - 1) area control centre;
 - 2) approach control;
 - 3) control tower;
 - 4) airline operations centre;
 - 5) meteorological office;
 - 6) military flight operations centre;
 - 7) general aviation operations centre;
 - 8) airport operations centre; and
 - 9) other;
- j) define the elements of common situational awareness:
 - 1) identify and utilize meteorological information that can be collaboratively used to assess meteorological impact to the system such as:
 - i) METAR and TAF information;
 - ii) prognostic websites and charts;
 - iii) satellite websites and charts; and
 - iv) meteorological radar;
 - 2) identify and utilize traffic display tools that can be collaboratively used to display traffic and geographical information.
- k) identify the appropriate means of ATFM communication:
 - 1) telephone conferencing systems
 - 2) web-based conferencing systems
 - 3) web-based information dissemination and discussion portal similar to a blog format
 - 4) e-mail dissemination portal
 - 5) electronic chat to support tactical discussion
 - 3) operational information web pages
- l) develop the applicable ATFM Operational Letters of Agreement.
- m) develop the procedures and training materials for FMUs and FMPs.
- n) develop the procedures and training materials for stakeholders.
- o) discuss and develop the ATFM measures that will be applied in order to balance air traffic demand and capacity.
- p) establish an implementation date for the ATFM service;
- q) train the appropriate personnel regarding the processes and procedures necessary for ATFM implementation;
- r) Implement the processes and procedures; and
- s) evaluate the results and coordinate changes as necessary.

Chapter 6

ATFM MEASURES

6.1 What are ATFM Measures and how are they established and applied?

6.1.1 ATFM measures are techniques used to manage air traffic demand according to system capacity. Some ATFM measures must be considered as control instructions or procedures. The determination is based on the size of the event, the coordination process, and the duration of the event.

6.1.2 ATFM measures are important initiatives for managing the flow of air traffic and are applicable when it is necessary to manage fluctuations in the air traffic demand, but they do cause an impact to the AUs. It is important to consider this impact and implement the measures that are necessary for maintaining the safety and efficiency of the system. Therefore, air traffic management personnel should employ the least restrictive methods available in order to minimize delays.

6.1.3 The set of ATFM measures applicable to any given area should be discussed collaboratively between the ANSP and AUs during an ATFM strategy conference. Application parameters, processes and procedures will be understood by all stakeholders from the outset which will avoid misunderstandings during operations. Any foreseeable capacity reductions (e.g. scheduled runway maintenance) or addressing a significant growth in demand in face of a limited capacity during certain periods of time (e.g. special or unforeseen events) would also be discussed at that time.

6.1.4 ATFM measures may only be required during certain periods of time when airports and ATC sectors experience delays due to demand and capacity related issues.

6.2 Types of AFTM Measures

6.2.1 ATFM measures can take a variety of forms and typically span the pre-tactical and tactical phases of the ATFM time horizon. The list below is not exhaustive and provides guidance on where the various measures fall on the ATFM timeline. Figure 4 summarizes these ATFM measures.

ATFM Measures			
	Strategic	Pre-Tactical	Tactical
Vertical			Rerouting (Level Capping Scenarios)
Lateral	Playbook Routes	Playbook Routes	Fix Balancing Rerouting (Rerouting Scenarios) Rerouting (Alternative Rerouting Scenarios) Playbook Routes
Longitudinal			Miles-In-Trial Minutes-In-Trial Minimum Departure Intervals
Time	Ground Delay Program Airborne Holding	Ground Delay Program	Slot Swapping Ground Delay Program Ground Stop Airborne Holding

Figure 4. ATFM Measures

6.2.1.1 **Miles-in-trail (MIT).** A tactical ATFM measure. It is the number of miles required between aircraft that meet a specific criterion. The criteria may be separation, airport, fix, altitude, sector, or route specific. MIT are used to organize traffic into manageable flows, as well as to provide space to accommodate additional traffic (merging or departing) in the traffic flow.

6.2.1.2 **Minutes-in-trail (MINIT).** A tactical ATFM measure. It is the number of minutes required between successive aircraft. It is normally used in airspace that is not provided with surveillance, when transitioning from surveillance to non-surveillance airspace, or when the spacing interval is such that it would be difficult for a sector controller to measure it in terms of miles.

6.2.1.3 **Fix balancing.** A tactical ATFM measure. This is assigning an aircraft an arrival or departure fix other than that in the filed flight plan in order to distribute demand and avoid delays. This can be used, for example, during periods of convective weather where a standard instrument arrival (STAR) or a standard instrument departure (SID) is unusable.

6.2.1.4 **Rerouting.** A tactical ATFM measure. It is an ATC-assigned routing other than the one shown in the filed flight plan. Rerouting can take a variety of forms, depending on the tactical situation.

6.2.1.4.1 **Rerouting scenarios:** Mandatory diversion of flows to offload traffic from certain constrained areas.

6.2.1.4.2 **Level capping scenarios:** Carried out by means of flight level restrictions (e.g., flights from London to Paris TMA shall file below FL245).

6.2.1.4.3 **Alternative routing scenarios:** Routes which are made available to AUs on an optional basis to offload traffic from certain areas.

6.2.1.4.4 A rerouting is normally issued to:

- a) ensure that aircraft operate along with a required flow of traffic;
- b) remain clear of airspace under restrictions or reservations;
- c) avoid excessively congested airspace; and
- d) avoid areas of known meteorological conditions that aircraft are circumventing or refusing to fly through.

6.2.1.5 **Minimum Departure Intervals (MDIs).** A tactical ATFM measure. Carried out when ATC sets a departure flow rate of, for example, 3 minutes between successive departures. MDIs are typically applied for no more than 30 minutes at a time and are typically applied when a departure sector becomes excessively busy or when capacity is suddenly reduced (e.g., equipment failure, meteorological conditions, etc.).

6.2.1.6 **Slot Swapping.** A tactical ATFM measure. Can be applied either manually or via automated means. The ability to swap departure slots provides AUs the possibility to change departure order of their flights that are filed through a constrained area. This measure provides AUs with the ability to better manage their business model in a constrained environment.

6.2.1.7 **Playbook routes.** A strategic, pre-tactical, or tactical ATFM measure. These are a set of collaboratively developed, published, pre-defined routes to address reoccurring route scenarios. They aid in expediting route coordination during periods of system constraint.

6.2.1.8 **Ground delay programme (GDP).** A strategic, pre-tactical, or tactical ATFM measure. A GDP is an air traffic management process where aircraft are held on the ground in order to manage capacity

and demand through a specific volume of airspace or at a specific airport. In the process, departure times are assigned that correspond to available entry slots to the constrained airspace or arrival slots to the constrained airport. The purpose of a GDP is to minimize airborne holding. It is a flexible programme and may be implemented in various forms depending upon the needs of the air traffic management system. GDPs are developed in a collaborative manner and are typically administered and managed by an FMU or national/subregional ATFM centre. If a GDP is scheduled to last for several hours, it may be necessary to revise the slots to reflect changing conditions. There must be a system in place to advise pilots of departure slots and any changes to the GDP.

6.2.1.9 Ground stop (GS). A tactical ATFM measure. It is a process that requires aircraft that meet specific criteria to remain on the ground. Due to a ground stop's potential impact on AUs, alternative ATFM measures should be explored and implemented prior to a GS, if time and circumstances permit. The GS is typically used:

- a) in cases where capacity has been severely reduced at airports due to significant meteorological events or due to aircraft accidents/incidents;
- b) to preclude extended periods of in-flight holding; to preclude sector/centre reaching near saturation levels or airport grid lock;
- c) in the event a facility is unable or partially unable to provide air traffic services due to unforeseen circumstances; and
- d) when routings are unavailable due to severe meteorological or catastrophic events.

6.2.1.10 Airborne Holding. A tactical ATFM measure that has been designed strategically. It is a process that requires aircraft to hold at a waypoint in a pre-defined standard in order to cope with short notice demand and capacity imbalances or to provide an inventory of aircraft that are in position to take advantage of short notice temporary increases in capacity such as during certain types of meteorological events.

6.2.1.10.1 During the strategic planning phase, stakeholders collaborate to determine suitable locations for the holding patterns. Analysis has shown that the optimal flight levels for airborne holding from a fuel efficiency perspective are FL200 – FL280. These flight levels provide a balance between the lesser fuel consumption for turbine-powered aircraft and the holding area size. Depending on the situation being considered, a lower altitude holding area can be designed in order to provide a small ready supply of holding aircraft that can take advantage of a short notice opportunity. Holding altitudes should be compatible with normal descent profiles in order to avoid excessive rates of descent and airspeeds and also to avoid inefficient holds at low altitudes.

6.2.1.10.2 Airborne holding is in tandem with Ground Delay Programmes and Ground Stops. Airlines may, in collaboration with the ANSP, choose to request that a small inventory of holding aircraft be maintained during periods of congestion in order to maintain arrival demand pressure on the approach and to avoid losing opportunities when departure demand is not constant or meteorological conditions are variable.

6.2.1.10.3 Airborne holding is a high workload measure for air traffic controllers and for pilots. Every effort must be made to simplify the procedures and minimize communications during the process. Consideration must also be given to potentially reduced sector capacity during airborne holding periods.

6.3 ATFM Measure Approval Authority

6.3.1 The coordination and approval of ATFM measures must be in accordance with the collaborative decision-making process established for the provisions of the ATFM service. Publication in national AIPs and/or regional supplementary procedures is recommended.

6.4 ATFM Measures Processing

6.4.1 Prior to implementation, the designated authority responsible for ATFM must identify the need for an ATFM measure, examine alternative options, and develop a justification for the ATFM measure. The ATFM authority will:

- a) discuss and coordinate the proposed ATFM measure with the receiving facility and stakeholders prior to implementation;
- b) notify affected facilities and stakeholders of the implementation in a timely and appropriate manner;
- c) continuously monitor and assess the ATFM measures to ensure they are producing the desired results;
- d) make any necessary adjustments, including the development of an exit strategy; and
- e) coordinate with and notify affected facilities and stakeholders of modifications and cancellations in a timely and appropriate manner.

6.5 Application of ATFM Solutions

6.5.1 ATFM continuously and pro-actively considers all possible air traffic flow management solutions through an iterative process, from the strategic planning phase through to the execution of operations. The anticipation of any events according to new information makes it possible to minimise their impact on the ATM system or to take benefit of any opportunity and fine tune the plan accordingly.

6.5.2 To resolve capacity shortfalls and improve the management of the system while minimising constraints, a variety of air traffic flow management solutions may have to be considered. Examples are shown in Figure 5 below.

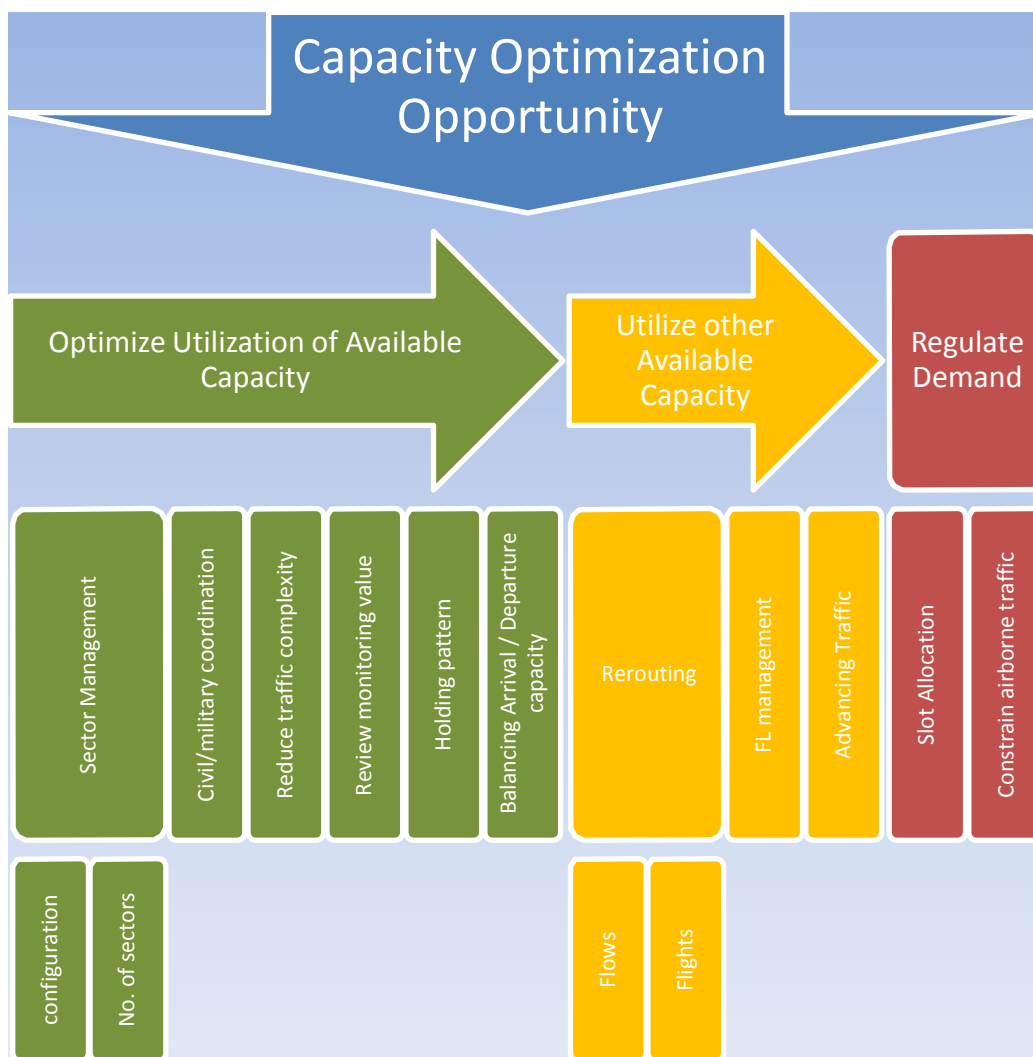


Figure 5. Capacity Optimization

6.5.3 Once the declared and available capacities have been established, air traffic demand can be monitored and assessed and ATFM measures can be coordinated and implemented to attain a balance in the system.

6.5.4 The following example provides a general idea of the steps involved in the actions/analyses to optimize the use of the ATM system:

- determine capacities: review/assess airport/airspace sector capacities for accuracy;
- assess demand: determine foreseen demand for a specific time frame, 15-minute period(s), hour(s), etc.;
- analyse and compare: analyse and compare demand and capacity levels, as well as the periods in which the demand exceeds the available capacity. Automated tools greatly enhance the ATFM analytical process;
- apply the CDM model: communicate the situation to the facilities/parties involved through the means available, using the CDM processes;
- determine the action required for mitigating a demand/capacity imbalance: after collecting and requesting information, determine the ATFM measures that are appropriate for the situation;

- f) disseminate information: inform the parties involved about the ATFM measures applied using the means available to that end;
- g) monitor the situation: examine the situation periodically, as necessary, to make sure that the ATFM measure applied is mitigating the imbalance. If necessary, re-assess and make the corresponding adjustments; and
- h) conduct an analysis after the event: following the event, conduct an analysis to determine the effectiveness of the ATFM measure, and catalogue the best work practices. This analysis may be conducted by reviewing the weekly or monthly report of the FMU/FMP.

6.6 ATFM Efficiency Calculation

6.6.1 ATFM measures should be based on principles set down in this guidance and all parties in the ATFM system should adhere to rules that ensure ATM system capacity is optimized in a safe and efficient manner and to the maximum extent possible. Efficiency takes into consideration fuel consumption and time factors and it should be noted that in some cases, the actions taken by ATFM units to balance capacity and demand will cause delay.

6.6.2 Delays have a great impact on AUs. Their route networks and schedules are built upon connections. The quality of these connections enables passengers to board on-going flights, ensures that aircraft are available for the next leg of flight, and manages the gate availability for subsequent aircraft. To AUs, the required service level requires on-time performance. From AUs perspective, every minute counts and delays represent costs. Although this perspective is understandable, it is not currently practical to measure ATFM delays to that degree. However, delays need to be accounted for and be analyzed so that impacts system performance.

6.6.3 As of yet, standardized ATFM delay calculation metrics across ANSPs have not yet been developed. This is due in part to the difficulties of defining what constitutes a delay as well as determining which, if any, party (such as ANSPs, airport authorities and AUs) has control over how delays are imposed or mitigated. In order to measure system efficiency and to identify issues affecting system performance, a global effort is needed to harmonize the definition of delay and methods of delay reporting. This effort should be a shared responsibility of the ANSPs, airports, AUs, and other stakeholders.

6.7 Principles of delay analysis

6.7.1 For practical and pragmatic reasons, the following considerations should be taken into account with regard to delays:

- a) common definitions must be agreed upon across ANSPs and other stakeholders;
- b) some ANSPs and airport authorities measure airlines On Time Departure performance, which then makes that metric important; and
- c) delays should be calculated for each phase of flight.

6.7.1.1 Departure

- a) all time in airline ramp/gate area should be measured;
- b) taxi time should be as short as possible for environmental and cost reasons. Aircraft should be held at the gate (or at a suitable intermediate location) until they can taxi to the departure runway with minimal time spent in the departure queue;
- c) all movement area delays should be measured, including taxi-out duration past normal taxi-out time; and

d) all time in penalty box/de-ice pads/etc should be measured.

6.7.1.2 En route

- a) all airborne holding delays should be measured;
- b) linear hold (route extensions, use of RTA, etc.) delays need to be measured; and
- c) sub-optimal routes imposed due to ATM infrastructure should be measured at a macro level and discussed during strategic Collaborative Decision-Making conferences.

6.7.1.3 Arrival

- a) on time arrival is more financially important to airlines than on time departure;
- b) consequential delays caused by cascading effects, if these can be determined, should only be measured once (e.g., Flight 2 has a delayed departure due to the aircraft being delayed on the inbound leg should not count as an additional delay); and
- c) all movement area delays should be measured, including taxi-in duration past normal taxi-in time.

6.8 Attribution and Accountability for ATFM Measures

6.8.1 There is a need for a common understanding among all ATFM actors on the reasons for ATFM measures and their accountable agencies (e.g. airport infrastructure, ANSP, external hazard, etc.). Appropriate and agreed definitions should be contained in local ATFM procedures. This is important both for a good operational understanding between operations staff and for performance reporting and regulatory oversight of the ATFM function where relevant. A set of guidelines of reasons for ATFM measures and accountable agencies is described below.

6.8.1.1 Factors under ANSP control

- a) flight calibration/flight check;
- b) equipment maintenance or failure;
- c) ANSP staffing;
- d) availability of mitigating strategies to mitigate the impact of capacity reductions due to
- e) abnormal meteorological conditions;
- f) flight arrival and departure sequencing; and
- g) non-optimization of capacity and configurations.

6.8.1.2 Factors under State control

- a) activation of restrictions or reservations of airspace that affects capacity;
- b) special events: airshow, VIP activity, special sports events; and
- c) availability of special use airspace during periods of adverse meteorological conditions or other constraints.

6.8.1.3 Factors under airport control

- a) airport infrastructure and configuration;
- b) airport construction affecting capacity;
- c) runway closure;
- d) taxiway closure;
- e) de-icing delays (exceeding unimpeded normal processing time);
- f) runway decontamination (sweeping, plowing);
- g) runway capacity reduced by airport operator failure to decontaminate;
- h) delay in completing a flight (deplaning) due to gate unavailability; and
- i) delay in completing a flight (deplaning) due to service unavailability (ground transport, handling, customs, etc.).

6.8.1.4 Factors under airspace user control

- a) inability to depart at ETD due to:
 - 1) delayed inbound aircraft; and
 - 2) flight preparation;
- b) inability to depart at a controlled departure (slot) time that is at or later than ETD.

6.8.1.5 Uncontrollable

- a) capacity reductions due to significant meteorological conditions or unforeseen events.

6.8.1.6 Delay classifications

- a) departure delay (actual versus planned departure time) e.g. ATOT minus ETOT or AOBT minus EOBT;
- b) ATFM delay, e.g. first CTOT minus EOBT;
- c) airline scheduling practices;
- d) time spent waiting in queue for take-off;
- e) total airborne holding minutes;
- f) route extension in time and distance, by flight phase; and
- g) arrival delay (actual versus planned arrival time).

6.9 Reporting

6.9.1 For reporting purposes, stakeholders should report delays at least monthly and include trend analyses. Delays should be broken down by reason and geographically to support analysis. ANSPs are encouraged to provide the data electronically in a format that would support further processing by stakeholders.

6.9.2 Following the publication of delay reports, ANSPs should meet with stakeholders to discuss the results and attempt to identify mitigations and corrective actions to improve performance.

6.9.3 Studies¹ have shown that there is roughly a 4:1 difference in cost between applying ground delays versus applying delays via airborne holding.

¹ FAA Economic Information for Investment Analysis, dated April 19, 2012

Chapter 7

DATA EXCHANGE

7.1 What data and information are exchanged in an ATFM service?

7.1.1 As a key enabler to support the global development and further harmonization of ATFM, the cooperation and coordination of ATFM activities between States must be enhanced. Therefore States should ensure that operational data from ANSPs (e.g. flight data information, delay information, meteorological information which have to be derived from a valid and authoritative source) are exchanged not only within their ICAO 4regions but also across ICAO regional boundaries, so that more efficient traffic flows can be achieved.

7.1.2 Data exchange is the sharing of information required for the effective provision of ATFM service. As depicted in Figure 6 below, the data to be shared include information related to the flight plan, capacity, demand, and ATFM measures for the purpose of cooperation and coordination of air traffic flow management activities between ATFM stakeholders.

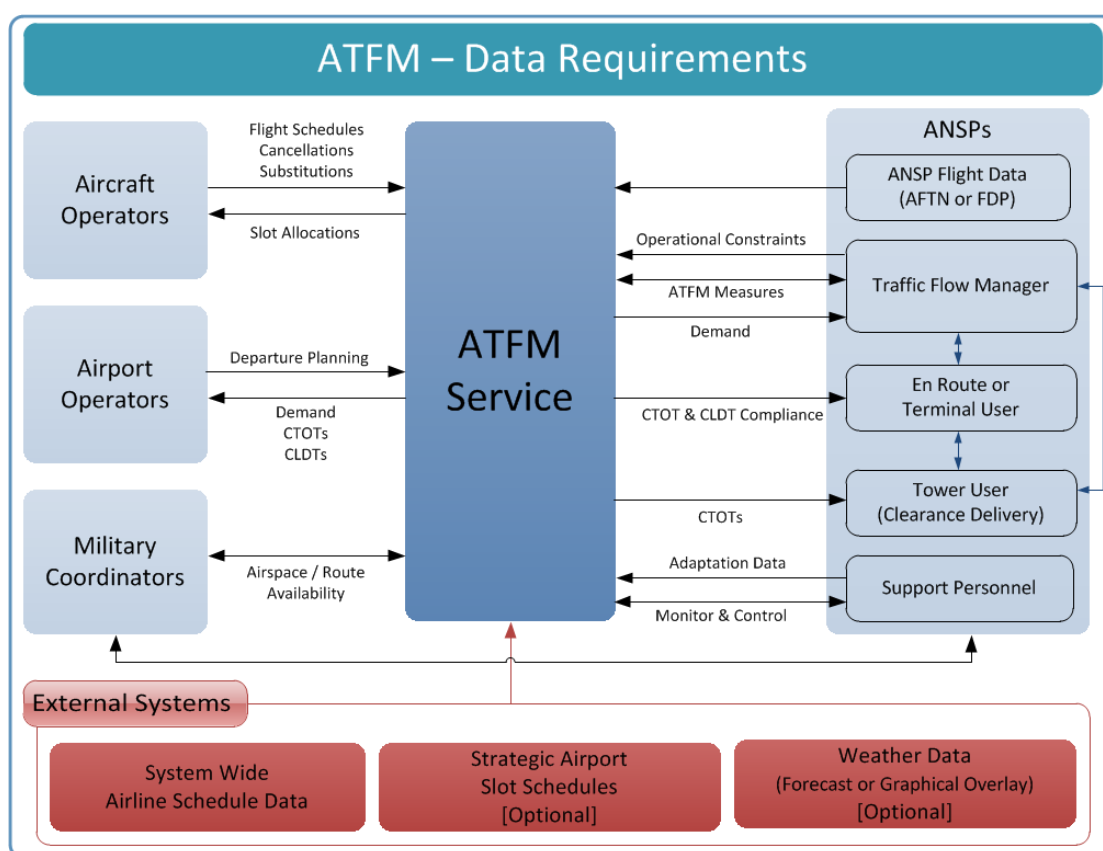


Figure 6. Data requirements.

7.1.3 The requirement for data sharing covers many different areas. As described earlier in this Manual, there is a requirement for the ATFM function to be constantly updated with information on the overall ATM resource (e.g., airspace status and airport infrastructure).

7.1.3.1 Many established ATFM units rely on databases that contain comprehensive details of the ATS organisation in their areas of responsibility. These databases contain essential information to ATFM planning and daily operations including ATS routes and routing systems, airports, SIDs, STARs, navigational aids (NAVAIDs), ATC sectorisation, etc.

7.1.3.2 Where such databases are available, the effectiveness of the ATFM service depends to a large extent on the completeness and accuracy of the associated information and on the timely exchange of data.

7.1.4 The ATFM unit also needs access to accurate and timely data with regards to the ATC demand. Throughout the various stages of the ATFM planning horizon (strategic, pre-tactical, tactical), AUs must provide descriptions of all flights intending to operate in the area under the responsibility of the ATFM unit. Accurate aircraft performance characteristics and meteorological models are also required in order to be able to correctly assess the impact of various operations.

7.1.5 It is of critical importance that the ATFM unit is provided with current information on the dynamic airport and airspace traffic demand and capacity situation in order to increase the accuracy of the tactical prediction.

7.1.6 Data information exchanged among stakeholders is applied to facilitate:

a) Strategic planning:

- 1) evaluate air traffic flows patterns;
- 2) evaluate capacity and demand problems and patterns;
- 3) collaborate and communicate with operational stakeholders;
- 4) validate and implement strategic ATFM measures for future events;

b) Pre-tactical planning:

- 1) monitor air traffic flows;
- 2) evaluate changing capacity and demand situations;
- 3) collaborate and communicate with operational stakeholders;
- 4) implement, revise, or cancel ATFM measures;

c) Tactical planning:

- 1) monitor air traffic flows;
- 2) evaluate changing capacity and demand situations;
- 3) collaborate and communicate with operational stakeholders;
- 4) implement, revise, or cancel ATFM measures;

d) Post operational analysis:

- 1) review and analyse previous day's (or even hour's) operation;
- 2) support and improve future planning functions and processes.

7.2 Benefits of Data Exchange

7.2.1 Data sharing and exchange facilitates the collaboration and interaction between national, as well as international, ATFM units and enables common situational awareness. It also allows for a coordinated and comprehensive system response to ever-changing conditions in the ATM system.

7.2.1.1 This enablement leads to increased safety and efficiency in air traffic operations, including: increased efficiency for traffic flows, reduced delays, enhanced predictability and reliability of AU schedules, and reduced impacts on the environment from greenhouse gas emissions and noise pollution.

7.2.1.2 It also optimizes contingency responses to unforeseen events and system disruptions.

7.3 International Data Exchange Specifications

7.3.1 To support the global development and harmonization of ATFM, ANSPs must ensure that the data shared is from a valid and authoritative source. ANSPs should utilize methodologies capable of data exchange that are secure, efficient, and in compliance with all applicable identified and agreed upon standards.

7.3.2 Flight data information is provided to ATFM units and operational stakeholders for the

purpose of air traffic management. Such data should not be released to third parties unless this is covered by a pre-defined data policy.

7.3.3 Specifications for connectivity should conform to existing standards for this type of data exchange and be documented by interface control documents.

7.4 Data Type Description and Harmonization

7.4.1 Automated ATC information contained in ICAO message types is the foundation for data exchange programmes. Examples of the ICAO message types are listed below:

- a) flight plan
- b) flight amendment;
- c) flight plan cancellation;
- d) flight departure;
- e) flight coordination; and
- f) flight arrival.

7.5 ATFM Tools

7.5.1 Depending on the size and complexity of the ATFM service to be provided, a set of ATFM tools may be implemented to enable partial automation of ATFM. Figure 7 provides an overview of ATFM tools to support planning, prediction, execution and analysis of ATFM measures.

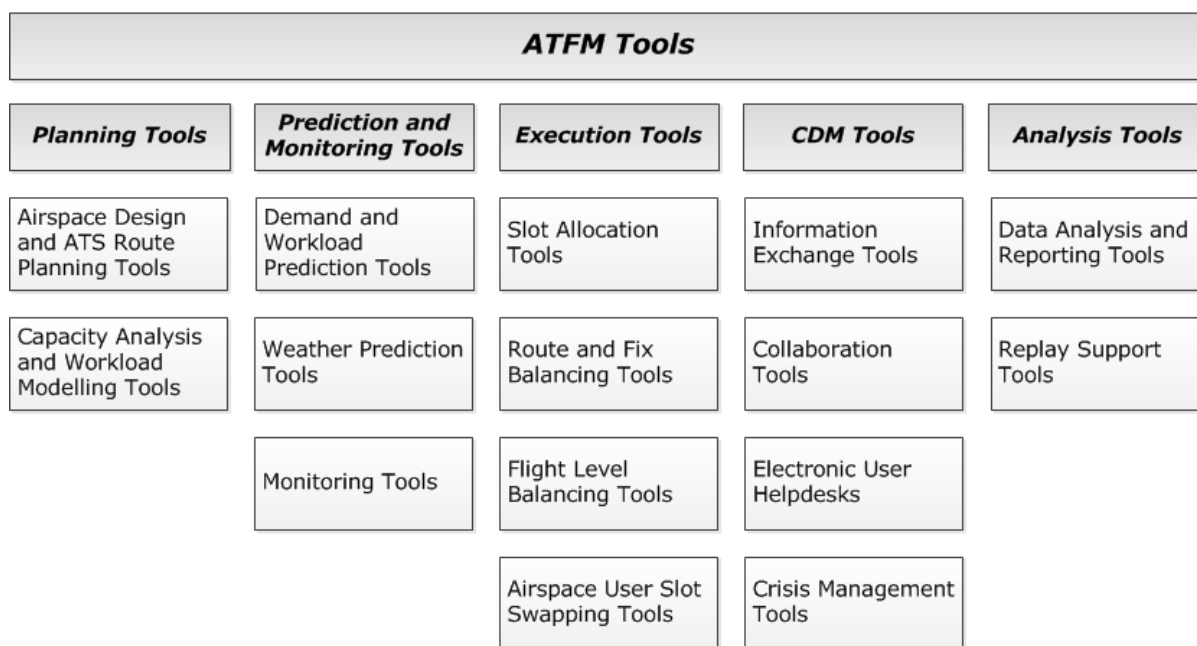


Figure 7. ATFM Tools

Note – If available, it is recommended to couple ATFM execution tools with ATC sequencing and metering tools, such as arrival and departure management systems (AMAN/DMAN), to achieve further capacity and efficiency benefits.

Chapter 8

ATFM COMMUNICATION

8.1 Communication

8.1.1 The communication and exchange of operational information among stakeholders on a real-time basis forms the backbone of ATFM. This exchange may be accomplished by a variety of means including telephone calls, web conferences, e-mail messages, electronic data exchange and web page displays. The purpose of the information exchange is to increase stakeholder situational awareness, improve operational decision-making, and enhance ATM system efficiency.

8.2 Stakeholder ATFM Communication

8.2.1 An ATFM unit requires several layers of communication. As a basis for the exchange of information, NOTAM and AIP supplements could be used to distribute instructions relating to the application of ATFM measures. For example, strategic ATFM routing information and certain ATFM operating procedures could be published as a NOTAM or in the AIP Supplement.

8.2.2 As the functionality of an ATFM unit develops, consideration should be given to developing a more ATFM specific communication structure for the notification of ATFM measures.

8.2.2.1 For example, to facilitate AU awareness, the ATFM unit could produce and distribute the ADP on the day prior to the operation in order to provide a summary of planned operations and ATFM measures in their area of responsibility and to distribute any specific instructions or communications requirements associated with those measures. This communication could also be updated by ADP amendments.

8.2.2.2 In order to ensure that AUs and other stakeholders can properly use and apply this information, a standard format should be employed.

8.2.3 In addition to the production and distribution of ADPs, the ATFM unit could produce ATFM Information Messages to provide information and guidance.

8.2.3.1 These messages could be used for the initial publication of changes to the availability of runways, ATS routes and airspace in the area, and serve as the vehicle for the initial publication of new and amended ATFM operating procedures which affect all users.

8.2.4 The ADPs and ATFM Information Messages could be transmitted via agreed-upon means to ATC units, AUs, and other stakeholders who wish to be included on the distribution list. These messages could also be made available on associated ATFM unit websites.

8.2.5 Each national AIP could include ATFM information on specific arrangements for dealing with ATFM issues and coordination matters. The AIPs could also include the telephone numbers of relevant ATFM units to contact for ATFM advice and information.

8.3 ATFM Communication Oversight

8.3.1 For consistency, the appropriate authority should ensure that there is a single office responsible for collecting, disseminating, monitoring, and providing oversight of the dissemination of ATFM information and ATFM measures. This oversight will ensure that applicable information is shared by all ANSPs and operational stakeholders in a timely and efficient manner.

8.3.2 Examples of applicable ATFM information include but are not limited to:

- a) tactical level information such as current airport runway configurations;

- b) airport acceptance rates;
- c) airport departure demand;
- d) en route sector demand and capacity imbalances;
- e) runway closure or airport conditions;
- f) NAVAID outages;
- g) ATM infrastructure; and
- h) activities on airspace under restrictions or reservations.

8.3.2.1 Specific categories of information will be determined by the ATFM unit in collaboration with stakeholders.

8.3.3 ATFM units should develop an internal operations manual for their respective facilities to address the ATFM measures process. For example, the operations manual could include provisions for:

- a) procedures for coordinating, implementing and disseminating ATFM measures through specified means such as telephone calls, aeronautical messages, web pages, or any other suitable method;
- b) constant monitoring and adjusting of ATFM measures; and
- c) timely cancellation of ATFM measures.

8.4 Communicating ATFM Information

8.4.1 There is a requirement for AUs and ATFM units to communicate and exchange information for the purposes of CDM and information dissemination.

8.4.2 Because the involvement of ATFM units and AUs may vary significantly, the tools for exchange of information must be geared to meet the stakeholder capabilities and requirements.

8.4.3 When selecting communication methods, consideration should be given to maximizing the value and content of the information and minimizing the time and workload required.

8.4.4 The following communication methods are offered as examples:

- a) scheduled telephone (or web) conferences. This consists of defining times at which the ATFM units will hold daily operational conferences to exchange ATFM information and to meet their operational needs;
- b) tactical telephone conferences. This consists of establishing a procedure to convene non-scheduled ATFM teleconference, held in real-time and at a tactical level, in order to make the necessary operational adjustments; and
- c) automated web page or ATFM operational information system. ATFM units may create a web page or an information system, containing relevant ATFM information (e.g. ADP). The purpose is to share information about the ATM system in order to develop a common situational awareness and minimize workload.

8.5 ATFM Web Pages

8.5.1 For ATFM units that elect to create web pages with relevant ATFM information, examples could include:

- a) airport operational status information:
 - 1) current and planned active runway configuration;
 - 2) airport acceptance rate/departure rate;
 - 3) information concerning delays – duration and outlook;
 - 4) meteorological information;
 - 5) scheduled flight inspections/calibrations;
 - 6) ATFM measures;
 - 7) low visibility procedures;
 - 8) de-icing operations; and
 - 9) airport or runway closures;
- b) airspace operational status information:
 - 1) actual and planned capacity by sector;
 - 2) anticipated demand by sector;
 - 3) meteorological conditions likely to affect capacity or demand;
 - 4) special use airspace status; and
 - 5) ATFM measures;
- c) ATFM stakeholder planning teleconferences:
 - 1) schedules; and
 - 2) joining instructions;
- d) ATFM strategic, pre-tactical, and tactical plans; and
- e) links to ATFM-related information:
 - 1) weather websites;
 - 2) ACC and APP contact information;
 - 3) Letters of Agreement;
 - 4) route information;
 - 5) GNSS operational status;
 - 6) ATFM-related NOTAMs; and
 - 5) contingency plans.

8.6 ATFM Terminology

8.6.1 What terminology/phraseology is used in ATFM?

8.6.2 One goal of this manual is to develop and promote standard terminology and phraseology for the exchange of ATFM telephone and automated messages. The information contained herein is intended to reflect the current use of plain language and provide a basis for harmonization.

8.6.3 ATFM operations should be conducted in a common language in a simple, concise, non-verbose manner. The use of local or regional colloquial terms or acronyms should be avoided due to possible confusion.

8.6.3.1 The exception would be coordination with stakeholders where the use of English may be required.

8.6.3.2 For interregional ATFM coordination, the English language should be used unless there is consensus to use another common language.

8.6.4 The use of standardized terminology as contained in this manual should be employed to guarantee global consistency on how ATFM messages are communicated among ATFM units. This includes

the concept of modular and structured ATFM messages and defines the components as who, what, when, where and why.

8.6.5 As with any communication model, it is the responsibility of both parties (sender and receiver) to ensure that the message is clear, concise, correctly understood and applied as requested.

8.6.6 Each ATFM coordination message should have five components (who, what, when, where, why) that contain plain language elements and when combined provide a complete ATFM message.

- a) **WHO:** This identifies the parties involved. Who is transmitting and receiving the message.

Examples: CGNA THIS IS COLOMBIA FMU
CENAMER ACC THIS IS PANAMA ACC
CCFMEX THIS IS ATCSCC
JCAB THIS IS CFMU

- b) **WHAT:** This identifies the objective to be achieved.

Examples: REQUEST 30 MILES IN TRAIL
REQUEST 3 MINUTES IN TRAIL
REQUEST GROUND STOP

- c) **WHEN:** This identifies the time and/or duration of the ATFM objective to be achieved.

Examples: FROM NOW UNTIL 1700 UTC
FROM 2000 UTC TO 2130 UTC

- d) **WHERE:** This identifies the location of the ATFM objective to be achieved. It is often preceded by a modifying clause, indicating what aircraft or traffic the restriction will apply to. The modifying clause and the location combination are used to construct the “where” component.

Examples: FOR ALL AIRCRAFT LANDING EL DORADO INTERNATIONAL AIRPORT
FOR ALL TRAFFIC LANDING CAIRO INTERNATIONAL AIRPORT
FOR ALL TRAFFIC FILED VIA B881

- e) **WHY:** This identifies the reason for the ATFM objective.

Examples: DUE TO SEVERE WEATHER OVER
EL DORADO INTERNATIONAL AIRPORT
DUE TO A LONG-RANGE RADAR OUTAGE
DUE TO EXCESS SECTOR DEMAND
DUE TO AN AIRCRAFT INCIDENT

8.6.7 Message example. The following is an example of a complete message:

CGNA THIS IS COLOMBIA FMU. REQUEST 30 MILES IN TRAIL FOR ALL AIRCRAFT LANDING EL DORADO INTERNATIONAL AIRPORT FROM NOW UNTIL 1700 UTC DUE TO SEVERE WEATHER OVER EL DORADO INTERNATIONAL AIRPORT

8.6.8 Message amendment. The amendment of an ATFM message should include similar elements but with additional modifiers. These modifiers may include:

- a) CHANGE;

- b) AMEND;
- c) REDUCE;
- d) INCREASE; and
- e) DECREASE.

8.6.8.1 Message amendment example.

GUAYAQUIL FMP THIS IS LIMA FMP, REDUCE YOUR MILES-IN-TRAIL TO JORGE CHAVEZ INTERNATIONAL AIRPORT FROM 30 MILES-IN-TRAIL TO 20 MILES-IN-TRAIL FROM 1400 UTC TO 1700 UTC DUE TO IMPROVING METEOROLOGICAL CONDITIONS AT JORGE CHAVEZ INTERNATIONAL AIRPORT

8.6.9 Message cancellation. The cancellation of an ATFM message should contain a cancelling word or phrase. Cancellation messages should also identify which message is being cancelled because several ATFM measures could be in place at one time. Normally, it is not necessary to state the reason for the cancellation, but it may be included. A cancelling word or phrase may include:

- a) CANCEL;
- b) RESUME;
- c) RESUME NORMAL; and
- d) RELEASE.

8.6.9.1 Message cancellation example.

CARACAS FMU THIS IS GEORGETOWN FMU, CANCEL THE GROUND STOP FOR CHEDDI JAGAN INTERNATIONAL AIRPORT DUE TO THE RUNWAY NOW OPEN

What resources are available to States regarding the various aspects of ATFM?

The information in the following Appendices pertains to the implementation of ATFM between 2006 and 2011 and represents the experiences of some States/International Organizations in the planning, implementation and application of ATFM. It provides samples and examples of information that can be used as resources and is designed to be helpful information with regard to implementing an ATFM service.

APPENDIX A

SAMPLE INTERNATIONAL ATFM OPERATIONS PLANNING TELEPHONE CONFERENCE FORMAT

Note.— This Appendix provides a sample format that can be used by an ATFM unit for facilitating an ATFM operations planning telephone (or web) conference.

Greeting and introduction

xxxxZ planning telcon
Covering the timeframe from xxxx UTC to xxxx UTC

Situation

The current situation is:

Issues

We will be discussing:

Common Weather Products – working from

- 1) the ICAO Area “ _ ” Prog Chart, valid xxxx UTC for (Date)
- 2) the ICAO Area “ _ ” IR Satellite photo, xxxx UTC for (Date)

Planning discussion – Recommend organizing the discussion by geographic areas (for example, from north to south, or east to west, in the regional airspace)

Significant meteorological and atmospheric conditions

Thunderstorm activity
Turbulence
Volcanic ash plumes

Terminal discussion

For select airports:
Airport/Sector Capacities
Projected terminal demand
Airport constraints, such as construction projects or NAVAID outages
Anticipated traffic management measures
Expanded miles-in-trail
Potential airborne holding
Potential ground stops

En-route discussion

En-route constraints, such as frequency outages or
NAVAID outages
Route discussion and issues
Anticipated traffic management measures
Expanded miles-in-trail
Potential airborne holding

Additions to the plan, including any pertinent tactical updates.

Stakeholder input, comments, and questions

Next Planning Telcon: xxxxZ

APPENDIX B

SAMPLE ATM DATA EXCHANE AGREEMENTS

Note.— This Appendix provides a sample format regarding an agreement for the exchange of ATM data between States.

AGREEMENT ZZZZ

BETWEEN

(State name)

AND

(State name)

THE EXCHANGE OF AIR TRAFFIC FLOW MANAGEMENT DATA

ARTICLE I - PURPOSE

The purpose of this Agreement is to establish the terms and conditions for cooperation between (State name) and (State name) in the exchange of non-critical radar and flight data information. The exchange of data will enhance the cooperation and coordination of air traffic management (ATM) activities between (State name) and (State name).

ARTICLE II - SCOPE OF WORK

A. (State name) and (State name) agree to exchange flight data and other information concerning international and domestic instrument flight rules (IFR) aircraft to enhance the cooperation and coordination of ATM activities. This data will be used by each for the following purposes:

1. Maintenance of a complete and reliable database for such information;
2. Dissemination to aviation users; and
3. Enhancement of cooperation and coordination of air traffic flow management activities between (State name) and (State name).

ARTICLE III - PROCEDURES

A. Purpose of Use -- The exchange of flight data and other information shall be exclusively for the purposes set forth in this Agreement. The use of the information and data for purposes beyond the scope identified in this Agreement, or the release of any information or data to a third Party not identified in this Agreement, must be authorized in writing by the party from which the information or data originated.

B. Coordination -- The Parties will meet at such times and places as may be requested by either Party to jointly review the program and consider new procedures or requirements. Activities to accomplish the objectives will be discussed at bilateral/multilateral meetings and documented by Chairpersons in reports of those meetings.

C. Scope of Data -- The flight data or information to be exchanged shall not include any sensitive data on flights exempted by either Party for security or safety reasons. The exchange of flight data or information applicable to sensitive State and military aircraft will be provided for those areas where the Parties have responsibility for provision of air traffic services. The data shall be formatted to be usable in each system and exchanged using data communications systems as mutually agreed.

D. Types of Data -- Types of data to exchange include non-critical radar and flight data information concerning international and domestic instrument flight rules (IFR) aircraft, including flight and flight plan

modifications, cancellations, amendments and related changes.

E. Communications Protocol -- The information shall be exchanged using agreed data communications protocol. Communications protocol and other necessary requirements shall be arranged as mutually agreed. The Parties agree to provide, at the earliest possible date, notice of proposals for the development of changes to hardware, software and documentation applicable to traffic management data and supporting interfaces.

F. Responsibility of Provision -- Except for technical or operational reasons, information and data will be exchanged continuously as it becomes available. Each Party shall operate and maintain communication hub(s) and line(s) to be used for data exchange.

ARTICLE IV - RELEASE OF DATA TO THIRD PARTIES

A. Data on State and military aircraft shall not be released to a third Party, unless approved through mutual agreement by both Parties.

B. All data may be released by (State name) or (State name) to aviation stakeholders through programs under the same terms and conditions found in the agreements entered into between the (State name) or (State name). Air Navigation Service Providers, aircraft operators, national security or safety authorities and research and development (R&D) institutes for ATM improvement are defined as aviation stakeholders. (State name) and (State name) shall be responsible for data administration in the provision for those Parties.

C. Each Party shall make every effort to ensure that the other Party's air traffic flow management data is not released or re-broadcast through unrestricted, public access mass media communications technology, such as the internet, without the written consent of the other Party.

ARTICLE V - FINANCIAL PROVISIONS

Each Party shall bear the cost of any activity performed by it under this Agreement.

ARTICLE VI - IMPLEMENTATION

A. The designated points of contact between xxx and yyy for coordination and management of this Agreement are:

- | | |
|----------------------|--------------------------------------|
| 1. For (State name): | Manager
Address- phone-fax-e-mail |
| 2. For (State name): | Manager
Address- phone-fax-e-mail |

B. The designated points of contact between (State name) and (State name) for technical issues under this Agreement are:

- | |
|----------------------|
| 1. For (State name): |
| 2. For (State name): |

ARTICLE VII - ENTRY INTO FORCE AND TERMINATION

This Agreement will enter into force upon the date of the last signature and remain in effect for the duration of its associated Annex. Either Party may terminate the Agreement on six (6) months' written notice to the other Party.

ARTICLE VIII - AUTHORITY

The (State name) and (State name) agree to the terms of this Agreement as indicated by the signatures of their duly authorized officers.

(State name): _____

(State name): _____

By: _____

By: _____

Title: _____

Title: _____

Date: _____

Date: _____

APPENDIX C

DETERMINING AIRPORT ACCEPTANCE RATE

Note.— This Appendix provides an example of a simplified methodology for determining the acceptance rate at an airport. This methodology is based on the scientific process developed by the Federal Aviation Administration for establishing the acceptance rate.

- Definitions:

1) **Airport Acceptance Rate (AAR):** A dynamic parameter specifying the number of arrival aircraft that an airport, in conjunction with terminal airspace, ramp space, parking space, and terminal facilities can accept under specific conditions during any consecutive 60 minute period.

2) **Airport Primary Runway Configuration:** An airport configuration which handles 3 percent or more of the annual operations.

- Administrative considerations:

1) Identify the organization responsible for the establishment and implementation of AARs at select airports.

2) Establish optimal AARs for the airports identified.

3) Review and validate the airport primary runway configurations and associated AARs at least once each year.

- Determining AARs:

1) Calculate optimal AAR values for each airport runway configuration for the following weather conditions:

a) Visual Meteorological Conditions (VMC) - weather allows vectoring for visual approaches

b) Marginal VMC - weather does not allow vectoring for visual approaches, but visual

c) Instrument Meteorological Conditions (IMC) – visual approaches and visual separation on final are not possible

d) Low IMC – weather dictates Category II or III operations

- Calculate the optimal AAR as follows:

1) Determine the average ground speed crossing the runway threshold and the spacing interval required between successive arrivals

2) Divide the groundspeed by the spacing interval to determine the optimum AAR

3) FORMULA: Ground speed in knots at the runway threshold divided by spacing interval at the runway threshold in miles

NOTE: when the quotient is a fraction, round down to the next whole number

Example: $130 \text{ KTS} / 3.25 \text{ nm} = 40$ Optimum AAR = 40 arrivals per hour

$125 \text{ KTS} / 3.0 \text{ nm} = 41.66$ round down to 41

Optimum AAR = 41 arrivals per hour

Or

Use table below

Nautical miles between aircraft at the Runway Threshold										
	3	3.5	4	4.5	5	6	7	8	9	10
	Potential AAR									
Ground Speed at the Runway Threshold										
140 knots	46	40	35	31	28	23	20	17	15	14
130 knots	43	37	32	28	26	21	18	16	14	13
120 knots	40	34	30	26	24	20	17	15	13	12
110 knots	36	31	27	24	22	18	15	13	12	11

Table 1. Optimum AAR

- Identify any conditions that may reduce the optimum AAR. Conditions include:

- 1) Intersecting arrival and departure runways
- 2) Lateral distance between arrival runways
- 3) Dual use runways – runways that share arrivals and departures
- 4) Land and Hold Short operations
- 5) Availability of high speed taxiways
- 6) Airspace limitations and constraints
- 7) Procedural limitations (noise abatement, missed approach procedures)
- 8) Taxiway layouts
- 9) Meteorological conditions

- Determine the adjusted AAR using the previous factors for each runway used in an airport configuration.

1) Add the adjusted AARs for all runways used in an airport configuration to determine the optimal AAR for that runway configuration.

- 2) Real-time factors may require dynamic adjustments to the optimal AAR. These include:

- a) Aircraft type and fleet mix on final

b) Runway conditions

c) Runway/taxiway construction

d) Equipment outages

e) Approach control constraints

3) Formula:

$$\text{POTENTIAL AAR} - \text{ADJUSTMENT FACTORS} = \text{ACTUAL AAR}$$

RUNWAY CONFIGURATION	AAR for VMC	AAR for MARGINAL VMC	AAR for IMC
RWY 13	24	21	19
RWY 31	23	20	17

Table 2. Actual AAR - Example

APPENDIX D

DETERMINING SECTOR CAPACITY

Note.— This Appendix provides an example of a simplified methodology for determining sector capacity at an ACC. This methodology is based on the scientific process developed by the Federal Aviation Administration for establishing the sector capacity.

- 1) Sector capacity is determined using the average sector flight time in minutes from 7am to 7pm Monday through Friday.
- 2) For any 15-minute time period.
- 3) The formula used to determine sector capacity is:

$$\frac{(\text{average sector flight time in minutes}) \times (60 \text{ seconds})}{36 \text{ seconds}} = \text{Sector Capacity Value}_{\text{optimum}}$$

- 4) Steps:
 - a) manually monitor each sector, observe, and record the average flight time in minutes.
 - b) after that time is determined:
 - 1) multiply that value by 60 seconds in order to compute the average sector flight time in seconds;
 - 2) then divide by 36 seconds because each flight takes 36 seconds of a controller's work time; and
 - 3) this is the sector capacity value (optimum).
- 5) Adjustments:
 - a) the optimum value for a sector is then adjusted for factors such as:
 - 1) airway structure;
 - 2) airspace volume (vertically and laterally);
 - 3) complexity;
 - 4) climbing and descending traffic;
 - 5) terrain, if applicable;
 - 6) number of adjoining sectors that require interaction; and
 - 7) military operations.

Alternatively the table below can be used.

Average sector flight time (in minutes)	Optimum sector capacity value (aircraft count)
3 minutes	5 aircraft
4	7
5	8
6	10
7	12
8	13
9	15
10	17
11	18
12 minutes or more	18

Table 1. Simplified method

APPENDIX E

CAPACITY PLANNING AND ASSESSMENT PROCESS

Note.— This Appendix provides information developed by EUROCONTROL to provide information related to the ATFM capacity and planning assessment process.

1. A performance-driven process

The overriding objective is to develop a capacity assessment process that contributes to the requirement to:

“provide sufficient capacity to accommodate the demand in typical busy hour periods without imposing significant operational, economic or environmental penalties under normal circumstances.”

To address this, an annual capacity planning and assessment process, a cyclical process that identifies and quantifies the capacity requirements for the short and medium-term, should be put in place.

To effectively determine future capacity requirements, it is necessary to monitor current capacity performance. The following indicators should be used:

- **Average ATFM Delay per flight**

The average Air Traffic Flow Management (ATFM) delay per flight is the ratio between the total ATFM delay and the number of flights in a defined area over a defined period of time.

The ATFM delay is described as the duration between the last take-off time requested by the aircraft operator and the take-off slot allocated by the ATFM function, in relation to an airport (airport delay) or sector (en-route delay) location.

- **Effective Capacity**

“Effective capacity” is defined as the traffic volume that the ATM system in the area concerned could handle with one minute per flight average en-route ATFM delay. This capacity indicator is derived from a linear relationship between delay variation and traffic variation.

2. Methodology to Assess Future Capacity Requirements

The objective of a medium term planning and assessment exercise is to provide predictions of the capacity requirement for the ATM system. This can be done in different ways, but preferably through the use of a Future ATM Profile (FAP), a combination of different modelling and analysis tools.

FAP comprises ATFM simulation facilities as well as spreadsheet and macro-based analysis and reporting tools that assesses and quantifies how much capacity is delivered by specific airspace volumes within the current ATM system, and evaluates the current and future capacity requirements, at ACC and sector group level.

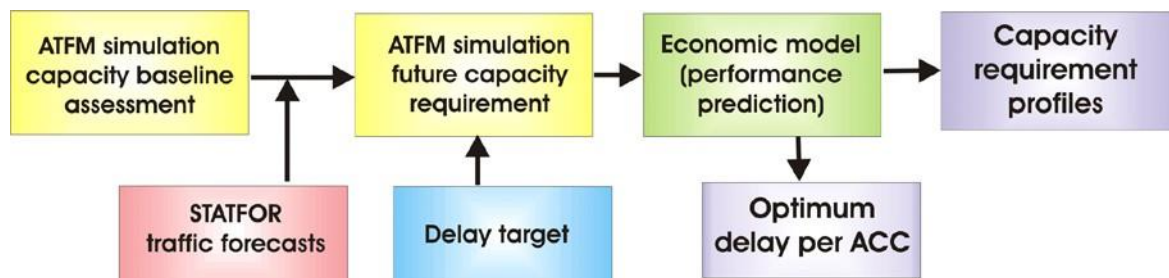
Step 1: In order to provide an accurate prediction of the capacity requirements of the concerned area, it is necessary to know the **current capacity offered**. FAP should establish a **capacity baseline** for each ACC and defined sector group.

Step 2: The next task is to provide a **prediction of the future demand** on each ACC (and defined sector group) over the next 5 years, according to the expected traffic growth and distribution over the future route network.

Step 3: FAP should carry out **an economic analysis**, balancing the cost of capacity provision and the cost of delay, on the assumption that each ACC is operating at or close to its economical optimum, and that the target level of delay has been achieved.

Step 4: FAP should then produce, for each ACC in the area concerned (if more than one) and each of the defined sector groups, a **5 year capacity requirement profile**. Percentage increases with respect to the measured capacity baseline are provided.

Figure 2: Key FAP processes:



3. Expected Demand on the Future Route Network

3.1 Medium-term capacity requirements

Medium-term capacity requirements at ACC or sector group level can only be assessed once one has a picture of the expected traffic volume and distribution over the future route network in the area concerned.

The expected demand at ACC or sector group level should be assessed by the FAP tool, from:

- the forecast traffic growth;
- the future route network evolution and traffic distribution, simulated by an airspace modelling tool;
- airport capacity constraints, assessed from information gathered from various sources on current and planned airport capacities.

3.2 Future Route Network Evolution and Traffic Distribution

The capacity requirement for an ACC or sector group is clearly dependent on the distribution of traffic over the network in the area concerned, horizontally and vertically. The demand to be accommodated in the future is determined, taking into account the desire of users to fly the most direct routes and optimum vertical profiles, in the context of the anticipated evolution of the route network.

Changes to the route network and traffic distribution can induce significant changes in terms of the demand (and therefore the required capacity) at individual ACCs, even during periods of reduced traffic growth.

It is assumed that aircraft will follow the shortest routes available on the network between city pairs according to the future route network, on essentially unconstrained vertical profiles. Nevertheless, some existing structural traffic distribution scenarios are retained. There is no ‘dispersion’ of flights between equivalent routes between city pairs.

Traffic flows respecting these assumptions should be simulated by the appropriate tools, and serve as an input to the FAP simulations. The result of these simulations should be a horizontal and vertical traffic distribution over the future route network, allowing the determination of the unconstrained demand in each ACC.

4. Cost Data and Economic Modelling

Capacity has a cost, but insufficient capacity, which in turn generates delay, has an even larger cost. Both capacity and delay costs are borne by airspace users. It is therefore necessary to determine the level of ATC capacity which can be justified from a cost point of view i.e. the optimum trade-off between delay and cost of ATC capacity.

The cost of capacity and the cost of delay are regional parameters depending on:

- total capacity provided
- marginal capacity cost (ATC complexity, price index, equipment, etc)
- total delay generated
- delay sensitivity (network effects, hourly traffic distribution)

- cost per minute of delay (traffic mix)

Consequently, each ACC has its own capacity cost and delay cost curves. These curves interrelate as network effects within the area concerned change according to changes in capacity offered at other ACCs.

The total cost curve (the sum of the delay cost and the capacity cost) determines the optimum cost model capacity for each ACC for the current traffic demand. However, to assess capacity requirements for the future, it is necessary to incorporate the future demand into the model in an updated total cost curve for each ACC.

4.1 Calculation of the Required Capacity Profiles

After the economic analysis or cost optimisation for the future traffic demand is carried out, the final step in the process takes place. FAP carries out another iterative ATFM simulation by increasing capacity at the ACC offering the best Return on Investment (ROI), until the overall delay target is reached.

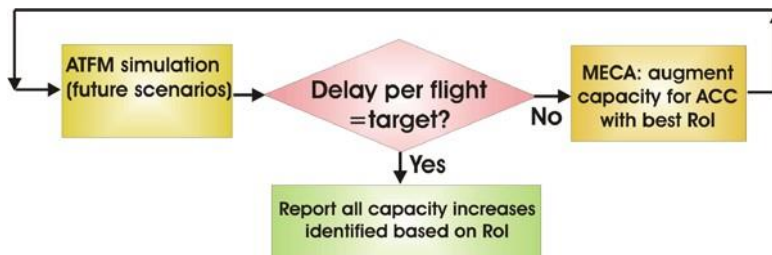


Figure 3: Iterative ATFM network simulations with best ROI to achieve target delay

When the agreed target delay is reached, the capacity target for each ACC is expressed in terms of the capacity increase that was necessary in order for the convergence to be achieved. Simulations are carried out for the final year of the planning cycle and for any year that there are changes to ACC or sector group configurations. Capacity levels are interpolated for intermediate years.

The capacity target level corresponds to the cost optimum delay for the ACC, to meet the overall delay target adopted by the appropriate authority, and represents the ACC capacity required to cover:

- the expected demand, and (if appropriate),
- the current capacity shortfall, i.e., the difference between the optimum capacity and the current capacity (as described in the previous section).

Figure 4 shows an ACC with a capacity surplus (blue), an ACC with a capacity shortfall (red) and an ACC with optimum capacity (green). For the ACC with optimum capacity, the requirement is only to cover the forecast traffic increase. For the ACC with a capacity shortfall, the requirement is to cover both the shortfall and the traffic increase, and for the one with a surplus, the requirement is to achieve the optimum capacity in the medium term, without costly over provision.

If the network delay is close to the target delay, the optimum delay at ACC level is an effective tool to identify areas that still have a capacity gap.

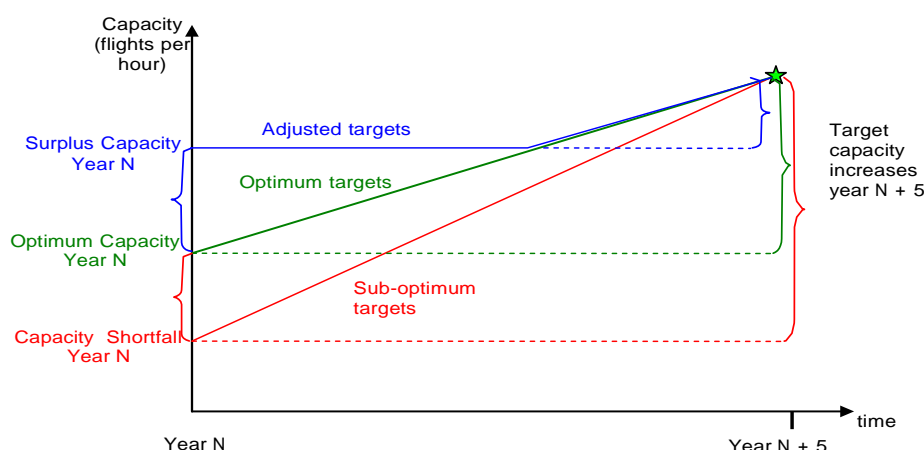


Figure 4: Current v. Target capacity

5. The Capacity Planning Work Programme

5.1 The table below describes the different phases of the annual work programme and lists the required actions and responsibilities.

EVENT	ACTION ATFM Function	ACTION ANSPS
<u>Oct- Dec</u> Capacity planning meetings for the short- and medium-term	Provide all relevant data to enable the ANSP to prepare a first draft of the local capacity plan <ul style="list-style-type: none"> as data becomes available, and at least 2 weeks before the meeting 	Prepare the draft capacity plan prior to the meeting with capacity enhancement function (CEF)
		Ensure the participation of both planning and operational staff at the meeting
<u>Nov - Dec</u> Completion of the capacity plan	Complete the capacity chapter <ul style="list-style-type: none"> by the end of December 	Finalize the capacity plan <ul style="list-style-type: none"> by the end of November
<u>Nov -Feb</u> ATFM and capacity report for previous year	Coordinate and agree with ANSPs the content with respect to the analysis of ACC performance <ul style="list-style-type: none"> by end January 	Review and agree the ACC performance analysis content provided by ATFM Function <ul style="list-style-type: none"> by end January
	Finalize report <ul style="list-style-type: none"> by end February 	
<u>January</u> Agreement and development of the medium-term capacity profile scenarios	Prepare the airspace scenario data for profile calculation following coordination with ANSPs <ul style="list-style-type: none"> by end February 	Provide ATFM Function with details of configuration changes (planned or proposed) during the 5 year planning cycle for ACCs and requested sector groups <ul style="list-style-type: none"> by the end of January

<u>February</u> Release of short- and medium-term traffic forecasts	Convene meetings and provide the forum for all relevant information to be included in the short- and medium-term forecast <ul style="list-style-type: none"> • during the calendar year 	To attend the user group meetings and to ensure that all information relevant to the traffic forecast is provided to the ATFM Function <ul style="list-style-type: none"> • by the end of December
	Provide the new Medium-Term traffic forecast <ul style="list-style-type: none"> • by the end of February 	
	Merge the short- and the medium-term traffic forecasts	
<u>March</u> Calculation of medium-term capacity profiles (including optimum delay per ACC)	Calculate the optimum delay for each ACC <ul style="list-style-type: none"> • by mid March 	To agree the capacity profiles and optimum delay per ACC for use as a basis for the local capacity plan <ul style="list-style-type: none"> • by end April
	Calculate the capacity requirement profiles for ACCs and requested sector groups <ul style="list-style-type: none"> • by mid March 	
<u>March</u> Calculation of the delay forecast for the coming vacation season and next 2 years	Make the delay forecast for the coming vacation season and the next 2 years <ul style="list-style-type: none"> • by mid March 	To ensure that the local capacity plan is up-to-date and accurate and to communicate any changes to ATFM Function <ul style="list-style-type: none"> • before mid February
<u>March</u> The annual meeting of a capacity planning task force	Organize the task force meeting, invite contributions, compile the agenda and write the report	To attend the meeting, with the appropriate planning & operational participation and be prepared to share best practice capacity planning
<u>April</u> Publication of the operations plan for the coming vacation season	Incorporate the vacation capacity plans into the plans <ul style="list-style-type: none"> by mid March 	To ensure that up-to-date capacity information for the coming vacation season is made available, and that any changes are communicated to the ATFM Function for inclusion in the plan <ul style="list-style-type: none"> • by end February • as they occur, throughout the vacation season
	Release the first version of the vacation plan <ul style="list-style-type: none"> • by mid March 	
<u>May</u> Coordination and agreement of medium term capacity profiles	Coordinate bilaterally with ANSPs and agree the profiles that will be used as the basis for local capacity planning in the medium-term <ul style="list-style-type: none"> • by end March 	

	<p>Present the capacity profiles to the next meeting of the appropriate authorities for approval</p> <ul style="list-style-type: none"> • May meeting 	
<p><u>June</u></p> <p>Publication of the medium-term ATM capacity plan</p>	<p>Collect and consolidate all the local medium-term capacity plans and complete an analysis of the expected situation at network and local level</p> <ul style="list-style-type: none"> • by end of April 	
<p><u>July</u></p> <p>ACC capacity requirement profiles published</p>	<p>To release document</p> <ul style="list-style-type: none"> • by end of July 	
<p><u>Jul - Aug</u></p> <p>ACC/sector group capacity baseline assessment period</p>	<p>Inform ANSPs of the reference dates and request confirmation of data quality</p> <ul style="list-style-type: none"> • by the end of June 	<p>To confirm that fully accurate sector capacity and opening scheme data will be provided to the ATFM Function</p> <ul style="list-style-type: none"> • 1 week before the reference period
	<p>Calculate the baselines for ACCs and requested sector groups, according to the airspace structure scenarios defined for the capacity profiles</p> <ul style="list-style-type: none"> • by end August 	
	<p>In addition to the baseline assessment, calculate the capacity baselines using appropriate simulation and calculation tools</p> <ul style="list-style-type: none"> • by end August 	<p>To ensure that the sector capacity and opening scheme data is sufficiently accurate for the baseline assessment</p> <ul style="list-style-type: none"> • two AIRAC cycles before the start of the AIRAC containing the measurement period
<p><u>Sep - Oct</u></p> <p>ACC capacity baselines coordinated with the ANSPs</p>	<p>Communicate the baseline results to ANSPs on a bilateral basis for discussion and agreement</p> <ul style="list-style-type: none"> • by mid September 	<p>To agree the capacity baselines for the next planning cycle</p> <ul style="list-style-type: none"> • prior to meeting of the appropriate authorities
	<p>present the agreed ACC baselines to the next meeting of the appropriate authorities</p> <ul style="list-style-type: none"> • October meeting 	

Table1. Actions, Deadlines and Responsibilities

Once per year, the ATFM Function should visit the majority of ANSPs in the area concerned to collect information on capacity plans for the next five years and the coming vacation season. It is essential to the improvement of ATM capacity at overall network level for each ACC to have a robust capacity planning process and a realistic capacity plan.

ANSP capacity plans for each ACC should be published in a local implementation plan, together with other relevant capacity information (e.g. capacity delivered during the previous vacation season, future capacity requirements, expected performance in the medium term and the current and expected capacity of major airports).

Prior to each meeting, the ATFM Function provides the ANSP with a set of data to enable them to prepare the preliminary capacity plan, tailored to local conditions. The data set should include the following:

- A report and analysis of capacity delivered during the previous vacation season
- The value of the (vacation) capacity baseline indicator for each ACC and requested sector group
- The optimum delay for each ACC, to meet the network target delay
- A set of 5-year ACC capacity requirement profiles for high, low and medium traffic growth (shortest available routes over the future route network) and for the current route network
- Similar capacity requirement profiles for requested sector groups
- Detailed medium-term traffic forecast
- The latest short-term traffic forecast per State
- Short and medium-term delay forecast for each ACC
- Differences in demand between current routes and shortest routes and current routes and cheapest routes scenarios
- Other relevant capacity information

ANSPs prepare a first draft of the capacity plan for the meeting, which is discussed and updated in an interactive session, using appropriate simulation and calculation tools. To facilitate the discussion and ensure a realistic capacity plan, ANSPs should ensure the presence of both planning and operational staff.

The plan should detail the capacity enhancement actions planned each year of the capacity planning cycle, together with a realistic assessment of the contribution of these initiatives to the overall annual capacity increase.

Attachment A: Definitions of terms used in this Appendix

Elementary Sector: Primary component of the airspace structure, one or more of which may be combined to form a sector. In some cases the elementary sector can be the same as the operational sector; in other cases, the elementary sector is never open operationally without being combined with one or more other elementary sectors.

Sector: Primary operational component of the airspace structure that can be considered as an elementary capacity reference of the ATM system. A sector is made up of one or more elementary sectors.

Sector Group: Group of sectors that strongly interact with each other through close and complex coordination, satisfying the agreed concept of operations.

Traffic Volume: Airspace component based on traffic flow that serves as a reference to design the ATC sectors.

Sector capacity: The maximum number of flights that may enter a sector per hour averaged over a sustainable period of time (e.g. 3 hours), to ensure a safe, orderly and efficient traffic flow. Some ANSPs manage sector capacities tactically over a shorter period of time (e.g. 15 minutes). However, for global assessment purposes, the hourly figure is used as standard.

Declared Sector Capacity or Monitoring Value: The value the ANSP declares to the CFMU as the maximum number of flights per hour that can enter a sector before the application of an ATFM regulation becomes necessary. Several values may exist - depending on the ATC environment at the time (airspace, equipment, traffic pattern, staffing, weather etc.). The value can change according to the situation at the ACC.

Declared Traffic Volume Capacity: The capacity for a given period of time for a given traffic volume, as made known by the ANSP to the ATFM Function, so that it can provide the ATFM service. As with Sector Capacity, the value can change depending on the ATC environment at the time at the ACC.

ACC/ Sector Group Capacity: The theoretical maximum number of flights that may enter an ACC or sector group per hour, over a period of time (e.g. 3 hours), without causing excessive workload in any of the sectors. This capacity indicator is used for capacity planning and monitoring purposes and has no operational value. The indicator is calculated mathematically using a validated methodology.

Capacity Baseline: The value of the capacity indicator (see above) for the ACC and defined sector groups

Capacity Profile: The evolution of required capacity over the five-year planning cycle, considering certain assumptions, for a specified volume of airspace (ACC or defined sector group), in terms of absolute demand (flights per hour) and annual percentage increases. These values are published annually and are used as a basis for local capacity planning by ANSPs.

Network Effect: The network effect is the phenomenon where regulations placed on parts of the network affect the demand structure observed in other parts of the network. Network effects range from simple interactions of cause and effect, to more complex interactions between groups of sectors, where causes are repeatedly re-triggered by effects, involving several oscillations before a stable equilibrium is reached. Affected sectors could be adjacent, in the same region, or distant sectors located on the far side of the ECAC zone.

APPENDIX F

PLANNING PROCESS FOR ATFM IMPLEMENTATION

1. Initial Planning Steps

1.1 The first step is to conduct an ATM system review to understand the basic systems and to collect critical data. Terminal airspace analysis should include a terrain and environmental (including noise abatement) assessment as part of the review. At a minimum, the review should ensure that there is feedback from:

- aerodrome operators (including adjacent aerodromes);
- airspace users (including military agencies);
- ATS units;
- instrument flight procedure design organizations; and
- meteorological offices.

1.2 The following eight phases should be considered for the review and initial planning:

1. Briefings for senior decision-makers on the scope, objectives, and expected deliverables of the project.
2. Review Planning – preparation of questionnaires, timetable, personnel and resources required.
3. Specialist familiarization visits, interviews and data collection, which includes:
 - capacity assessment;
 - ATS communication and surveillance capabilities;
 - barriers to optimal use of available capacity;
 - possible capacity enhancements and costs of those enhancements; and
 - future changes that may affect the ATM system with regard to capacity.
4. Completion of current system review and analysis of options.
5. Stakeholder consultation of draft recommendations.
6. Analysis of stakeholder feedback and draft report preparation.
7. Stakeholder agreement.
8. Report for senior decision-makers.

2. Planning for Implementation

2.1 The decision to implement ATFM can be for en-route operations, or for a specific aerodrome and/or the terminal control area serving that aerodrome, or for all flight phases within a specific volume of airspace, as appropriate.

2.2 The following six phases need to be considered during ATFM implementation:

1. Consideration and procurement of ATFM facilities and tools.
2. Procedure development.
3. Training needs analysis.
4. Training development.
5. Initial ATFM implementation.
6. Review and measurement of outcomes.

2.3 The implementation of tactical ATFM capability can involve optimization of processes and the establishment of practices supporting ATFM at this operational phase such as:

- Airspace and ATS route re-design;
- Instrument flight procedure re-design;
 - Segregation of all SIDs from all STARs;
 - Simplification of SIDs and STARs.
- Establishment of agreed acceptance rates;

- Amendment of holding patterns to allow continuous descent operations (CDO) if possible and an orderly flow to the Initial Approach Fix (IAF) or TMA “gate”;
- Establishment of agreed flow “gates”;
 - Repositioning feeder fixes at uniform distances from the aerodrome.
- Prioritization of landing aircraft;
- Determination and industry notification of any periods where carriage of additional fuel for traffic delays is required;
- Establishment of flow coordination agreements between ACC and ATFM units when necessary;
- Training organization and simulation for ATFM;
- Enhancement of ATFM related knowledge, skills and procedures, for ATC personnel including:
 - use of standard phrases for delaying action (ICAO Doc 4444);
 - early advice to pilots of expected delays;
 - absorbing delays in the cruise if and where possible;
 - maximizing the use of speed control to achieve delays;
 - optimization of separation minima;
 - use of vectoring to:
 - Increase track miles to adjust time;
 - Meet set course times or Required Time of Arrival (RTA) if the aircraft does not have this internal capability;
 - Continuous descent during vectoring.
 - development of ATC skills in vectoring and holding for efficient sequencing;
 - any holding and vectoring for delay to be conducted outside congested terminal airspace;
 - terminal operations (re-sequencing missed approaches, speed control within terminal airspace, wind monitoring and runway change procedures, non-normal events such as short notice runway closure, rejected approaches);
 - aerodrome operations (wind monitoring, runway change procedures, non-normal events); and
 - use of new ATFM tools and terminologies.
- Development of any required additional competency measurements for inclusion in local ATC performance assessment tools;
- Enhancement of communication systems related to ATFM and CDM;
- ATM system adaptation changes; and,
- Industry engagement in ATFM policy decisions.

2.4 Definition of responsibilities

2.4.1 In establishing ATFM each stakeholder have specific responsibilities:

- Directorate-General of Civil Aviation
 - Authorization, regulation and oversight of the ATFM Plan.
- ANSP Headquarters (Programme Sponsor):
 - Agreement on objectives;
 - Providing progress briefings within HQ and to the DGCA;
 - Coordination with ATC managers;
 - Approval of procedure changes, training plans and competency criteria changes; and
 - Review of outcomes.
- ATS unit management
 - Management oversight and local sponsorship of the plan;
 - Provision of progress briefings and reporting to Program Sponsor;
 - Allocation of specialist staff;
 - Local review and approval of proposed procedure changes, training plans and competency criteria changes;
 - Local implementation of agreed ATFM Procedures;
 - Review of outcomes;
 - Quality Assurance/Safety Management Specialist;

- Oversight En-route ATC aspects of the ATFM plan;
- Ensure proposals comply with safety regulations; and
- Inter-unit coordination agreements (as amended by the ATFM plan).
- Training Specialist
 - Training needs analysis and training development;
 - Development of specific competency criteria;
 - Close coordination and cooperation with ATS unit specialists;
 - Provision of expert information and advice on the current operating environment and control practices;
 - Data gathering activities;
 - Procedure recommendations;
 - Advice on training needs analysis and training development; and
 - Review of outcomes.

2.5 In order to determine a safe, orderly and ATC achievable per-hour arrival rate to each runway the following information must be considered for the training needs analysis:

- Radar separation standards.
- Wake turbulence separation standards.
- Visual separation by tower.
- Number of required departures per hour.
- Runway Occupancy time.
- Language and other airline-specific issues.

2.6 As a guide, the following underpinning knowledge and practical skills should be included in ATFM related competency assessment:

- Aircraft performance.
- Aircraft speed data.
 - holding pattern requirements
 - descent speed limitations
- Establishing a sequence.
- Coordinating the sequence.
- Changing the sequence.
- Vectoring for sequencing.
- Holding for sequencing.
- Application of available separation standards.
- Use of standard phraseologies.

3. Structure

3.1 The planned ATFM unit may be composed of Flow Management Units and Positions such as:

- Strategic management unit;
- Pre-Tactical Management Unit;
- Tactical Management Unit;
- Capacity Unit;
- Operability Monitoring Unit;
- Coordination and Decision Unit; and
- Flow Management Positions (established in the Area Control Centres and also in the Approach Control in the area of responsibility of the unit.

3.2 Duties

ATFM unit:

Strategic management unit – it is the duty of the strategic management unit to analyze, with at least more than one prior to the day of operation, the behavior of the demand and the volume of airspace, identifying situations of imbalance between demand and capacity, taking into consideration only scheduled flights and an estimation of general aviation flights, and planning the SLOT distribution at airports and volumes of airspace that present congestion and saturation scenarios.

Pre-tactical management unit – it is the duty of the pre-tactical management unit to update the plan set in the strategic management unit with more accurate information on the evolution of capacity and flight intentions (demand), taking into account the meteorological data, infrastructure, special events, etc. Usually, this update is carried out within a period of one day prior to day of the flight until the beginning of the tactical operation. And, during this time:

- Some traffic flows can be redirected;
- Less congested routes can be coordinated;
- Tactical measures will be decided; and
- The details of the ATFM planning for the next day will be disseminated to all concerned.

The evolution of the capacity and flight intentions request a growing volume of CDM interactions, involving, gradually, levels of decision making closer to the operation. The information to be processed in the pre-tactical management unit are the RPL, the FPL, the operations observed in the correlate days of the previous weeks, weather forecasts, inoperability due to scheduled or corrective maintenance, and other updated data that can contribute to the evaluation of the strategic planning. In this unit, measures are defined, for tactical application, with the purpose of mitigating possible impacts in case the scenarios provided above are confirmed.

Tactical Management Unit – Considering that the previous units provided an updated planning of the operations that will take place in the aerodromes and airspace, the duty of the tactical management unit is to track the occurrence of unexpected factors that may affect the capacity and/or demand, applying and monitoring the measures that will mitigate the impacts on the flow.

When the traffic demand exceeds, or is expected to exceed, the capacity of a particular volume of airspace or aerodrome, the unit shall inform the flow management position of the ATS unit concerned and other responsible ATS units. The airspace users who planned to fly in the affected area should be informed, as soon as possible, about the restrictions that will be applied.

In this unit, it also takes place a detailed monitoring of the weather, equipment and/or systems inoperability, and any other factors affecting capacity. At the same time, the demand must be permanently examined, observing the incoming of ATS messages. The proposed air traffic flow management measures should be evaluated within a CDM environment and, once set, disseminated to all interested parties. From then on, the established measures are continuously monitored and adjusted until their cancellation. All actions carried out in the tactical management unit must be registered and consolidated in a daily management report in order to support a quality evaluation of the services provided, creating indicators for the airspace and airport infrastructure planning.

Capacity Unit – It is the duty of the capacity unit to calculate the values for ATC capacity, according to the recommended methodology, as well as to evaluate those values periodically.

Operability Monitoring Unit – It is the duty of the operability monitoring unit to:

- Compile all information on the operational status of the elements that affect the air traffic flow, keeping other units informed about degradations;
- Generate operational reliability indexes of the elements that support the airport, terminal control area and enroute operations;
- Establish the operational priority for the maintenance and restoration of the degraded, inoperative or unavailable technical elements; and
- Monitor the actions carried out by maintenance, aiming at predicting the date and time normality is restored.

Coordination and Decision Unit – It is the duty of the coordination and decision unit to support CDM and the necessary coordination between airspace users, airport operators and civil and military aviation authorities. It is, usually, equipped with teleconference equipment; and

Flow Management Positions - It is the responsibility of the flow management positions (FMP) to:

- Inform, immediately, to the ATFM unit to which they are related to all changes on the infrastructure supporting airport, terminal control area and enroute operations that may generate an impact on the system (unavailability and/or restriction of aids, communication systems, radars, visualization and data processing systems, changes on procedures that affect the TMAs or FIRs, meteorological conditions, airport infrastructure unavailability, etc.);
- Coordinate with the ATFM unit, whenever deemed necessary, the adoption of ATFM measures in a given location or volume of airspace;
- Develop, monitor and analyze, together with the ATFM unit, ATFM measures, procedures and initiatives that are specific to their area of responsibility;
- Keep a complete record of all ATFM measures and procedures used, including description, start and end times, units involved and reasons;
- Develop, together with the FMP of adjacent units or with the APP supervisors and in coordination with the ATFM unit, strategies for arrival and departure of aircraft in order to balance demand and capacity for each aerodrome;
- Inform the ATFM unit on any use of air traffic flow control by the ATS units and monitor the impacts until its cancelation;
- Propose to the ATFM unit the cancelation of the ATFM measures when they are no longer necessary;
- Coordinate with the local airport administration in order to minimize the impact of blockages as regards the runways, taxiways, parking lots and others aerodrome facilities;
- Notify the units involved on ATFM measures; and
- In addition to the duties set forth in the preceding paragraphs, the FMP installed on ATS units must have knowledge of the procedures contained in the operational documentation pertinent to the unit, with the aim of supporting supervisors on duty in special situations that may arise.

OPERATIONAL REQUIREMENTS

For the implementation of its activities, the ATFM unit should have:

- Means (system or process) to monitor the functioning of all systems and equipment which are requisite for air navigation and air traffic management;
- Immediate access to all information made available by the aeronautical information management (AIM) units;
- Detailed meteorological information, including systems for reproducing images originating from weather satellites and/or meteorological radars;
- A database with appropriate coverage, reliability, consistency and integrity to carry out its activities. This database should contain, among other things, information about:
 - airports;
 - ATC capacity;
 - air traffic demand;
 - airspace structure;
 - navigation aids; and
 - statistics on the use of airports and volumes of airspace.
- Access to regular flight schedules and estimates of non-scheduled flights, looking towards the strategic and pre-tactical planning of air traffic flow management;

- Access to all flight plan messages and messages correlated for the tactical operation;
- Radar information, when available, with coverage of its respective area of responsibility and equipped with selection and filtering resources;
- Automated resources needed for performing its activities, particularly for the general knowledge of the whole system status, decision support, effectiveness evaluation of specific measures and performance indicators. Among others, it is recommended to automate the processes of:
 - data gathering, analysis and distribution;
 - data base maintenance;
 - demand evaluation;
 - sequencing of en route traffic aiming at and within terminal control area;
 - departure sequencing;
 - slot allocation; and
 - proposal of alternative routes.
- Means of voice and data communications required for systemic functional relations. The means of voice and data communications should include teleconference with, among others, the following units and/or users:
 - main airlines;
 - main ATS units;
 - flow management positions;
 - bodies related to aeronautical meteorology; and
 - military users.
- Qualified, experienced and, depending on the job, duly authorized staff to perform its activities;
- A situation room, specially equipped to serve as a place for contingency and crisis management, special operations and severe deterioration;
- Facilities devoted to the simulation, revisualization of events and training of its operations, and
- Charts of the airspace and airport structure.

Note – The FMP, depending on the implementation strategy of the ATFM service, should have the same requirements above, in smaller proportions in order to serve only the area of responsibility corresponding to the ATS unity they support.

OPERATIONAL CRITERIA

Moreover, for carrying out the Air Traffic Flow Management service, the ATFM unit and/or FMP should consider the following:

- The restoration of the technical means, after occasional inoperability, will take place according to the priorities established by the ATFM unit/FMP, based on the impact on the system capacity. In this activity, it should be given due consideration to the issues regarding the civil-military integration of the system;
- The use of airspaces reserved or under restrictions by other interested parties will be permitted only upon express manifestation of the ATFM unit/FMP following established procedures;
- The necessary measures to solve preventively the occurrence of saturation and congestion of volumes of airspace should be established collaboratively by ATS supervisors, involved airspace users and ATFM unit/FMP. In the absence of an agreement, the ATFM unit/FMP will arbitrate the measures it deems most appropriate, according to established procedures;
- The automation of the processes inherent to the ATFM unit/FMP should consider human factors. The architecture of the automated processes should consider the best relationship between the remote processing of data and the communications means;
- The requirement of experience in the selection of human resources for the ATFM unit/FMP should be understood as experience in ATS units in charge of areas of significant air traffic density;

- The ATFM unit/FMP will ensure continuity of the civil-military cooperation and optimal utilization of existing resources; and
- The determination of capacity values will be effected according to specific methodology and parameters, validation of results and periodic assessment.

-END-