*International Civil Aviation Organization*
CAR/SAM REGIONAL PLANNING IMPLEMENTATION GROUP (GREPECAS)
**Fifth Meeting of the GREPECAS Aerodromes and Ground Aids / Aerodrome Operational Planning Subgroup (AGA/AOP/SG/5)**
Montevideo, Uruguay, 20 to 24 November 2006

**Agenda Item 8: Any other business**

# DEMAND AND CAPACITY BALANCING

(Presented by the Secretariat)

**SUMMARY**

This Information Paper contains a statement on activities related to reviewing demand and capacity balancing in airspace and airports the NAM/CAR/SAM Regions, the impact of operational congestion, its consequences on flight delays and identifies measures to relieve these problems.

**References:**

- Assembly Resolutions in Force, A35-15, (Doc 9848)
- ICAO, Strategic Objectives
- ICAO, Annex 11, 13th edition
- ICAO, Annex 14, 4th edition
- Global Air Traffic Management Operational Concept(Doc 9854)
- Air Traffic Services Planning Manual (Doc 9426)
- ICAO, Forecasting Manual on Air Traffic (Doc 8991)
- ICAO, Circular 304, 2004
- Report of the GREPECAS/13 Meeting
- Report of the ATFM/TF/2 Meeting, Bogota, Colombia, June 2006
- ACI/IATA, Airport Capacity / Demand Management
- IATA, Worldwide Scheduling Guidelines
- ACI Policy Handbook, 2003
- FAA, Airport Capacity and Delay, AC N° 150/5060-5
- http://www.google.com (capacity, demand, delay, airports, models ->).

## 1. Background

1.1 During the GREPECAS/13 Meeting it was decided that the AGA/AOP/SG would work jointly with the ATM/CNS/SG in the Air Traffic Flow Management (ATFM) Task Force since airport and airspace operations are intertwined. To date, the ATFM Task Force is using the Basic General Model of Analysis for its work **(Appendix A)**.

1.2 The GREPECAS/13 Meeting recalled that the ICAO 11th Air Navigation Conference concluded –Recommendation 1/1 "Endorsement of the global ATM operational concept", that ICAO, State and regional planning and implementation groups (PIRGs) should consider the Global ATM Operational Concept as the common global framework for planning ATM system implementation and for developing transition strategies for the implementation of ATM systems based on the global ATM Operational Concept.

1.3 Additionally, and keeping in mind analyses of main traffic flows carried out in the CAR/SAM Regions, there are airspace sectors that already experience traffic congestion, mainly during special and peak periods, due primarily to different capacities of the various ATC systems, inadequate operational planning and airport infrastructure limitations.

1.4 Considering traffic increases and the need to develop a harmonized ATFM system between NAM and CAR Regions NACC/DCA/2 Meeting approved an interregional strategy. The Meeting was of the opinion that for ATFM implementation in the CAR region, States, Territories and International Organizations should consider their specific requirements and necessities; therefore Working Groups must begin studies for implementation of demand and capacity balancing measures. Some States have already taken the initiative to implement these measures.

1.5 The C/CAR WG/6 Meeting noted that air operation saturation periods have occurred with increasing regularity, caused by an annual traffic growth of up to 7%. It is foreseen that this problem will increasingly affect operations as traffic flows grow between the NAM and SAM Regions, to/from the CAR Region and on flows between CAR and Europe. Measures to improve efficiency of air operations management are needed to deal with these impacts.

1.6 Similarly, the ATFM/TF/2 Meeting noted that several air operation saturation periods have occurred in CAR/SAM FIRs. Considering present and future traffic growth, the Meeting agreed that ATFM implementation should be made in phases in order to permit a progressive evolution and achieve the desired system capacities, in accordance to Doc 9854. **Appendix B** to this Information Paper includes guidance material for developing ATFM databases and a model of the CDM process agreed to by the ATFM/TF to progress demand and capacity balancing interregional works.

## 2. Discussion

2.1 According to Doc 9854 – Global Air Traffic Management Operational Concept, ATFM implementation should be done in phases so as to ensure a progressive evolution and that the required system capacities are achieved. Each phase should be implemented based on operational requirements, descriptive documents and operational models, according to the regional strategy agreed, and in the following sequence:

a) Strategic ATFM
b) Pre-tactical ATFM
c) Tactical ATFM.

2.2 Doc 4444, PANS-ATM, indicates basic procedures that should be observed when implementing phases of ATFM service. Doc 9854 also provides guidelines for improvement of Airspace Organization and Management (AOM), Flexible Use of Airspace (FUA), Airport Operations and Traffic Synchronization (TS), including Airspace User Operations (UO) related to ATFM systems.

2.3 The Doc 9426 indicates that the ATFM service within a region or other defined area should be developed and implemented as a centralized ATFM organization supported by flow

management positions (FMPs) established at each area control centre (ACC) within its area of applicability. **Appendices C and D** to this Information Paper describe procedures and processes for an ATFM Strategy and Regional Operations Plan. The procedures governing the provision of ATFM measures and services should be prescribed in a regional ATFM manual or handbook.

2.4 In the event that traffic demand regularly exceeds capacity or when it becomes apparent that forecast traffic demand will exceed the available capacity, the affected ATFM units, in consultation with aircraft operators, should consider implementing measures aimed at improving the use of the existing system capacity and should develop action plans to increase capacity so as to meet the forecast demand. **Appendix E** describes Demand and Capacity Balancing Management.

2.5 To meet this objective, the ATFM service must takes measures to ensure a balance exists between air traffic demand and the declared capacities and help air traffic control (ATC) to use, to the maximum extent possible, its capacity (**Appendix F**). In order to accomplish this, the ATFM unit (FMU) must monitor air traffic and, if applicable, issue management initiatives to keep a safe, orderly and efficient movement of air traffic.

2.6 The main responsibility of airport administrations and air navigation services is assuring the safety, regularity and expeditious flow of: ***aircraft, apron services, baggage, passengers, freight and ground transport arriving at airports.***

2.8 The air transport system, from the standpoint of capacity, is made up of the ***airline, air traffic and the airport.*** Any interference with the process that links them generates a delay in the system as a whole. This results in inconveniences in terms of use of time and its associated costs for users and the components of said transportation system and ultimately for the local, regional and global economy.

2.9 The efficiency of the airport system depends on many factors, from the consistency of its master plan, accurate forecast of demand (aircraft operation, passenger/freight), mode of airspace configuration and use, management of operational procedures and the timely incorporation of technologies, among others.

2.10 In the process of analysing demand and capacity balancing, it is necessary to first determine the nature, characteristics, limitations, changes and regional trends pertaining to airspace and airport operations. In this context it is necessary to note that with respect to the subject under study, its importance resides on the degree of integration, exchange, coordination, understanding and consensus reached among States, Territories and Organizations concerned, with respect to the implementation of methodologies and compliance with standards and management indicators in the handling of operational flows.

2.11 The important principle is that the primary solution to the problems of airport congestion is increased capacity. It is essential that airport operators, together with ATC, airlines and other parties concerned, should endeavour to remove or change constraining features so that the airport can reach its full capacity potential. Schedule adjustments should only be necessary when all possibilities for reducing the limiting components of airports have been exhausted.

2.12 Knowledge of characteristics, management and demand forecasts are essential data for the planning, operation and maintenance of airport capacities. Dependable and duly refined historical series that include the number of aircraft, passengers and freight; hourly and peak time; daily and peak day; weekly, monthly and yearly data for periods between ten and twenty years should be obtained. The series must classify aircraft by their origin, destination and characteristics; passengers by origin, destination and type of travel; and, with respect to freight, by origin, destination, mass and volume.

2.13 The inventory of causal variables is very important in the different methods of forecasting. Among others, it is necessary to highlight historical trends, population of the influenced area, macro economic variables, special activities in the influence zone, plans of air carriers, trends in aircraft technologies and tariffs on modes of transportation.

2.14 Among the most common types of models for the study of demand we can mention the following: adjustment of curves to temporary series observed in the past; the one corresponding to the view of experts; DELFOS model (printed with list of questions for opinion of experts in different disciplines) and the market analysis with demand surveys among other methodologies for the development of forecasts. With regard to mathematical models, the regression model is the simplest and most widely known (See Doc.8991-AT/722).

**Identification of actions to improve demand and capacity management**

2.15 From discussion and analysis of remarks related to demand and capacity management, the following general actions could be incorporated according to the appropriate level of the process identified:

**Regional Level**

- Develop action plan for recording mechanisms and databases with delay times and associated causes. This would allow the implementation of common management criteria that anticipate appropriate safeguard actions to reduce delays and prevent congestion;

- Discuss, concur and apply, starting from a given date, standards and management indicators to reduce delays at airports. It is necessary to agree on how many minutes shall be considered a reportable delay (several States have considered 15 minutes), and the preparation and publication of formats in which delay time (minutes) can be monitored allowing an accurate measurement of delay for each affected flight; the stage of aircraft operation in which they occur (parking area, taxiing for departure, take off, arrival, arrival taxiing), the recording of those delays exceeding *X* min., and the associated costs;

- Consider the implications for airlines, airport operators and ATS providers who participate actively in the implementation of technology and associated management procedures to reduce airport and airspace congestion, producing higher runway acceptance rates and more efficient traffic flows, and encourage the analysis, research and incorporation of RNAV/RNP procedures and discussion of the Gate-to-Gate concept.

- Discuss and establish regional commitments in order to accomplish the reduction of delays as a strategic objective.

**Local Level** (State)

- Incorporate electronic tools and technologies in the management of air traffic flows and navigation aids;

- Improve organization and management of airspace;

- Establish points of contact to carry out coordination between Aviation Authorities and/or ATS providers of adjacent FIRS in order to agree on the development of common strategies to reduce delays;

- Improve traffic movement on taxiways, holding areas and aprons;

- Continuously update Master Plans, including the development and maintenance of demand forecasts according to the methods most suitable to the resources available;

- Generate and maintain effective links that foster better coordination of airport schedules and planning of air traffic services;

- Prepare and/or update as appropriate, the airspace demand and capacity studies (basic model of analysis, forecasts, consideration of associated risks/uncertainties); establish a baseline and alternative scenarios; determine objectives and strategies to relieve congestion, augmentation of horizontal and vertical infrastructure capacities, latest generation technologies for air traffic management, and measures for optimizing operational management.

- Develop and implement a strategic action plan for daily teleconferences and advisories to share critical information on demand and capacity balancing in the near term in accordance with **Appendix D** to this Information Paper.

## 3 Conclusion

3.1 Demand and capacity management in the NAM/CAR/SAM Regions must be treated as a strategic issue of regional interest. Punctuality in the operation of the air transport system is the main characteristic and the critical success factor that users of the system rely upon. Whether airport or airline operator or airport concessionaire, it is one of the main variables that determines higher or lower operational costs. Therefore, it is necessary to develop strategies and objectives (near and medium term), based on regional policies which can subsequently be easily evaluated and improved upon, as necessary, demand and capacity.

3.2 This will be possible only through an effective CDM process, based on the willingness and interest of States, Territories and International Organizations, and with a common strategy to meet objectives that will foster reductions in delays and increased reliability of service which will be perceived by investors and tourists interested in the CAR/SAM Regions.

## 3 Suggested action

3.1 Bearing in mind the abovementioned information, the Meeting is invited to:

a) note the information presented in this Information paper;

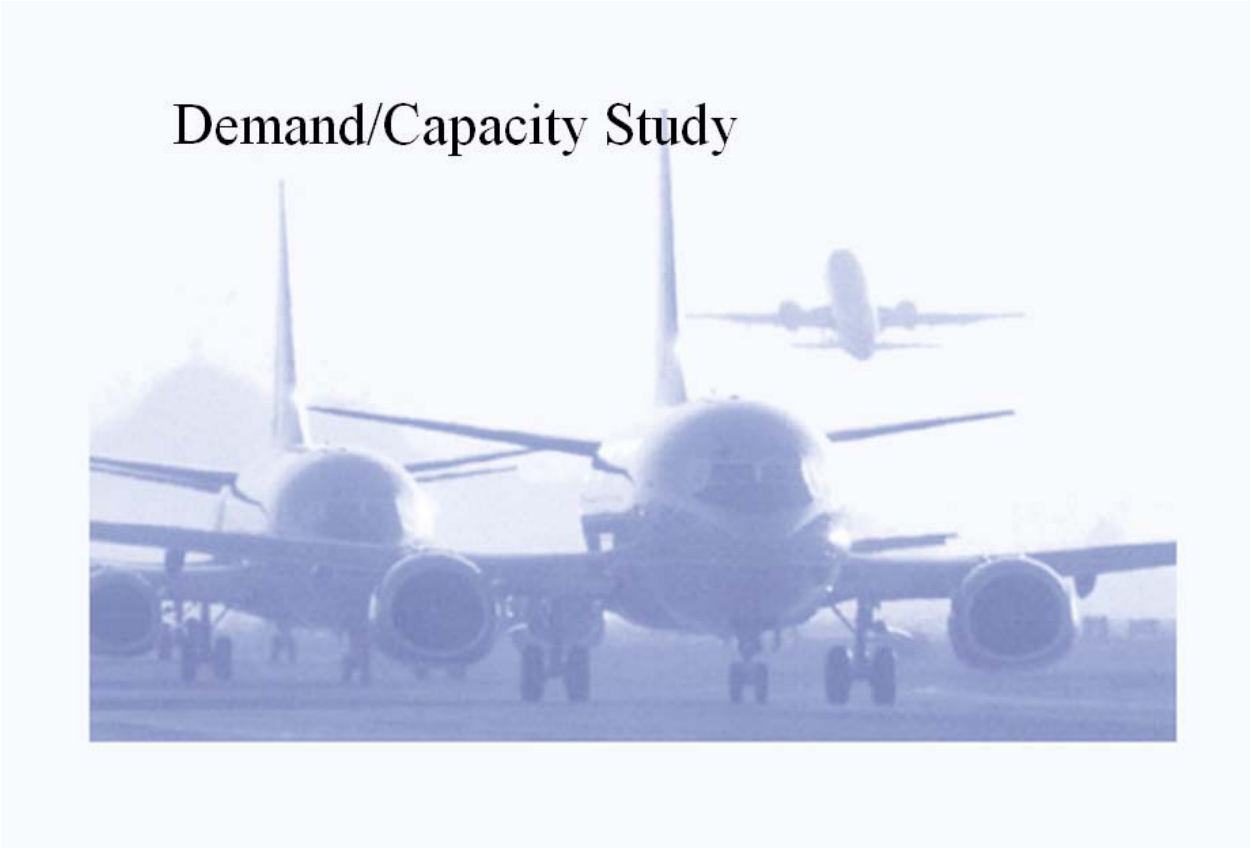
b) survey operations to identify traffic constraints at airports and in airspace of the ECAR;

c) organize a Task Force and identify points of contact to discuss traffic growth trends and develop ATFM solutions in the short term for the Cricket World Cup (14 March – 28 April, 2007);

d) recommend appropriate actions to improve demand and capacity balancing in the airspace and international aerodromes of the ECAR; and

e) recommend other actions as appropriate.

**APPENDIX A**



**1. Identification of Remarks in the Management of Demand.**

1.1 From the analysis performed on data described in the Reference, we may conclude that factors more frequently included in this type of analysis and which directly affect airspace capacity and contribute to delays are as follows:

- Planning and awareness of demand and capacity;
- Type of aerodrome (hub, terminal, seasonal);
- Air traffic control (airspace organization and management);
- Type and level of technologies supporting air traffic control;
- Human Factors;
- Length, heading, and number of runways and procedures for different types of operations;
- Topographical characteristics of the surroundings (limitations on simultaneous departures and arrivals, obstructions, etc);
- Layout, number and characteristics of taxiways and holding bays;
- Type, characteristics and mixture of aircraft;
- Meteorological conditions, especially wind, rain and fog;
- Condition of runway surfaces;
- Category of operation of runways and associated navigation aids and downgrading criteria in case of failures;
- Number, layout and associated management of parking sites;
- Environmental restrictions (noise and emissions);
- Special situations such as: unlawful interference, aircraft emergencies, labour demands of aeronautical personnel and airline crews;
- Participation, discussion, analysis and coordination mechanisms for planning schedule v/s airport operational availability.

1.2 With regard to the aircraft operator the following factors may be mentioned:

- Schedule Planning;
- Type of flight (short, medium or long haul)
- Ground handling management.

1.3 From the analysis of above factors, we may conclude in this first phase of the Task that the most frequent problems contributing to delays are:

- Lack of historical data concerning number of aircraft operations, passengers/freight and its relation to the behaviour of local, regional and global macro economic variables;

- Too many external players in decision making process for the definition and mode of development of horizontal and vertical infrastructure capabilities;

- Delays in discussion and timely updating of Aerodrome Master Plans;

- Lack of practical effectiveness of agreements of Airport Operational Committees concerning actions for reducing delays;

- Lack of mechanisms for coordination and development of mutual benefits between the Aeronautical Systems of neighbouring States for reducing delays;

- Differences in planning and schedules of implementation of concepts and new technologies (CNS/ATM, GNSS, Free Flight and Gate-to-Gate Operations);

- At the local level (State/Territory), a lack of policies and coordination for the analysis and approval of air carrier schedules;

- Lack of standards and performance indicators for determining maximum delay times which will not be considered a reportable delay;

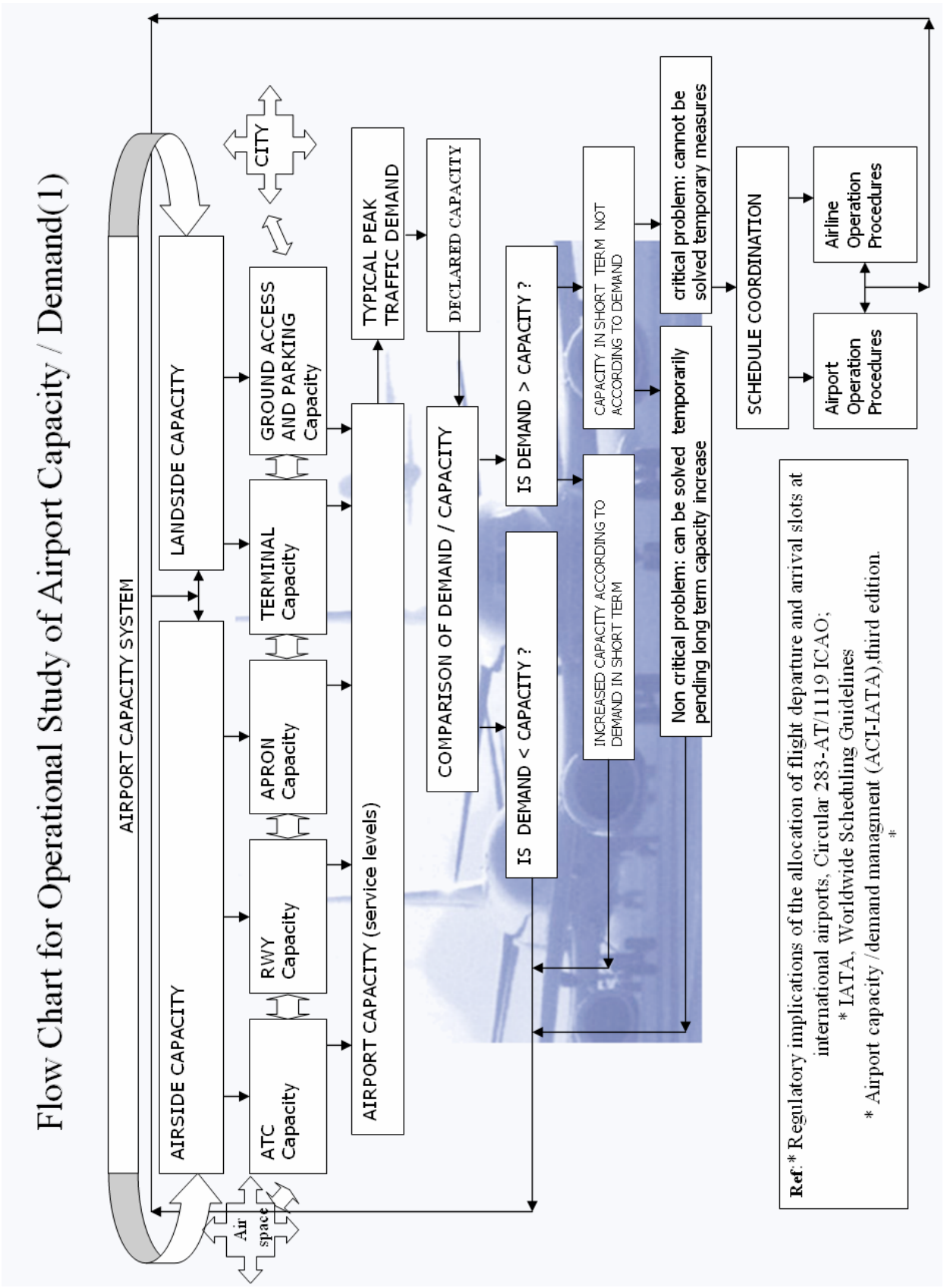
- Lack of information at the regional level detailing how airports manage delays;

- Lack of public dissemination of information on compliance or non-compliance with arrival and departure times;

- Pending implementation of benchmarking concepts in the management of punctuality of aircraft departures/arrivals;

- Pending management of schedules that include measures to address system constraints based on demand and capacity balancing (ICAO, Circular 283-AT/119);

- The airside capacity studies do not consider sufficiently the risk factors (safety, economy and politics) and associated uncertainties in the establishment of base lines and possible scenarios of demand behaviour.


Flow Chart for Operational Study of Airport Capacity / Demand(1)
AIRPORT CAPACITY SYSTEM
AIRSIDE CAPACITY
LANDSIDE CAPACITY
ATC Capacity
RWY Capacity
APRON Capacity
TERMINAL Capacity
GROUND ACCESS AND PARKING Capacity
CITY
Air space
AIRPORT CAPACITY (service levels)
TYPICAL PEAK TRAFFIC DEMAND
DECLARED CAPACITY
COMPARISON OF DEMAND / CAPACITY
IS DEMAND < CAPACITY ?
IS DEMAND > CAPACITY ?
INCREASED CAPACITY ACCORDING TO DEMAND IN SHORT TERM
CAPACITY IN SHORT TERM NOT ACCORDING TO DEMAND
Non critical problem: can be solved temporarily pending long term capacity increase
critical problem: cannot be solved temporary measures
SCHEDULE COORDINATION
Airport Operation Procedures
Airline Operation Procedures
Ref: * Regulatory implications of the allocation of flight departure and arrival slots at international airports, Circular 283-AT/1119 ICAO;
* IATA, Worldwide Scheduling Guidelines
* Airport capacity /demand managment (ACI-IATA),third edition.
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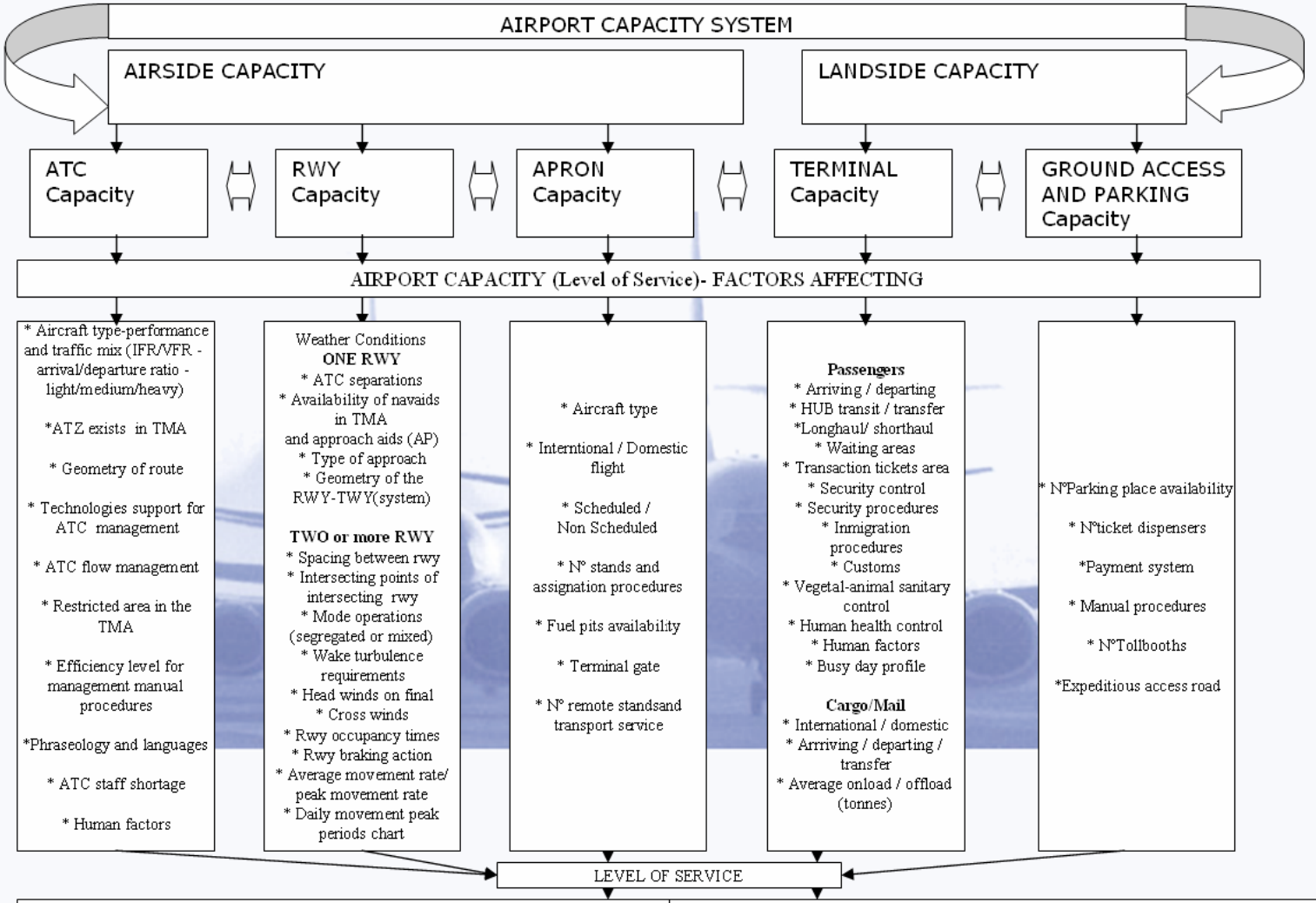
# Factors to analyze in each segment of the Airport and Level of resulting services (2)



# APPENDIX B

## COLLABORATIVE DECISION MAKING (CDM) PROCESS

The purpose of collaborative decision-making is to satisfy the declared levels of capacity and efficient use of resources, and allows all members of the ATM community, especially airspace users, to participate in ATM decision-making that affects them. The level of participation reflects the level to which the decision will affect them.

Collaborative decision-making applies to all layers of decisions, from longer-term planning activities through real-time operations. It applies across all concept components of the ATM system and is an essential element to achieving an acceptable solution, taking into account the needs of those involved. The rules for determining priorities for access to an ATM resource will have been collaboratively agreed in advance, applied both actively and, through agreed procedures, passively.

Effective information management and sharing will enable members of the ATM community to each be aware, in a timely manner, of the needs, constraints and priorities of other members in relation to a decision-making issue. Collaborative decision making can occur between airspace users directly, without any involvement of an ATM service provider. Any member of the ATM community can propose a solution.

Where a service provider is involved in collaborative decision making because of a requirement of the ATM system, it is often the ATM service provider who will propose a solution for consideration by the airspace user, as the service provider is aware of the requirements of other users and service providers and the collaboratively agreed rules for resolving competing requests for an ATM resource. However, because it is an information rich environment where the airspace user may have access to the same information as the service provider, the airspace user may understand why the particular solution is proposed.

A user can propose an alternative solution that addresses a user's preference that is not known to the service provider. In the same way the service provider can reject the user's proposed solution because of an ATM requirement that the user is not aware of.

*Information Management*

Information management aims at integrating the ATM network in the information sense, not just in the system sense. It forms the basis for the migration from the past one-to-one message exchange concept to the future many-to-many information distribution and to geographically dispersed sources which collaboratively update the information, with dissemination to many geographically dispersed destinations.

Managing the quality, integrity and accessibility of this complex, growing web of distributed information will ensure that the information needs of ATM stakeholders, both within as well as outside the ATM network, will be satisfied in a much more flexible and cost-effective manner than previously.

Decision-making is a normal operational process, but decisions will be of a better quality and engender greater confidence because accurate and validated information in the right form, in the right place and at the right time is shared. An open systems environment and better information management will allow information sharing on a much wider basis than hitherto, and will support a permanent dialogue between the various partners, throughout all phases of flight.

Automated systems are a big support for CDM and ATM en-route services. The aim of these systems is conformance and safety monitoring.

*Phases of flight*

Through CDM in the departure and landing phase of flight, ATM service delivery management might ensure that flights can arrive at the runway in time for their take-off slot and at the same time to integrate them with all the other departing and arriving flights in order to ensure safety and to optimize the use of the parking locations, ramps, taxiways and runways. The ATM service delivery management will ensure that service providers are given access to real-time data on projected arrivals and departures, runway loading, airport congestion, parking locations and environmental considerations, in order to reduce the inefficiencies in aircraft and vehicle movements. Within the en-route phase of flight, ATM service delivery management will be involved in matching ATM service capabilities with demand — e.g. traffic flow characteristics — by a range of means, including, inter alia, dynamic re-sectorization in ATM service centres, changes to route structures or airspace organization, or changes to conflict management modes.

The phases of a flight, from its inception at a scheduling or planning stage, through its actual operation, to its completion at an arrival parking location, are as follows:

a) planning — integration into the ATM environment to achieve a close match between user preferred trajectory and system delivered trajectory;

b) ramp — moving of the aircraft in and out of the parking locations;

c) surface-departures — moving aircraft from ramp to departure queue;

d) departure — the departure queue and the runway are managed to launch aircraft from the queue into the airspace;

e) dispersion — where aircraft get up and out of the terminal area into the en-route structure;

f) cruise — in which the aircraft is at altitude and moving towards its destination, but not yet subject to actions related to its arrival phase;

g) collection — the state in which aircraft are sequenced and spaced to bring them into the terminal area for arrival;

h) approach — in which aircraft are assigned to runways and onto the surface;

i) surface-arrival — moving aircraft off runways and to the ramp; and, once again

j) ramp — working the aircraft into the parking location.

## *ELECTRONIC DATABASES REQUIRED FOR THE ATFM SYSTEM*

1. Information management ensures that the information needs of ATFM stakeholders are satisfied in a much more flexible and efficient manner than previously. It is achieved by integrating all information to continuously maintain the best possible scenario of the past, present and future traffic situation. This becomes a common basis for decision making by all ATM stakeholders during their strategic, pre-tactical and tactical planning processes, including real-time operations and post-flight activities. The electronic databases required in evolutionary phases for the ATFM system are:

a) Data processing and display for traffic flow management

- Flight planning and processing data (FPL, RPL, etc);
- Airspace and airport structure;
- Situational air traffic display;
- Automatic messages in CDM support (access to SLOTS, delay reporting alternative routes, etc.)
- Monitoring status of air navigation infrastructure;
- Airport acceptance rate capacity (AAR);
- ATC capacity;
- Traffic demand;
- Airspace structure and ATS routes network;
- Air navigation aids, radar, etc;
- Aircraft performance;

b) Surveillance data (SSR, ADS, etc.)

c) AIS (mapping, ATFM warnings, AIRAC updating, etc)

d) MET

e) Historical and statistical analysis of air operations, meteorology, etc.

f) Communication system to support CDM with:

- Other ATFMC;
- Other FMUs and/or FMPs and/or ATS units;
- Users and operators (airlines, general aviation, State, etc.);
- Airport authorities;
- MET authorities;
- AIS authorities

### *Evolutive phases of data bases for ATFM automated systems*

#### *Strategic*

1. Refers to long-term information required for a coordinated, strategic plan of demand and capacity up to a year or more in advance of a particular airspace activity. While full schedule information might

not be known until some months or weeks before a particular flight, normally certain data is available many years/months in advance, and aids in pre-planning. Strategic programming includes:

- historic demand from scheduled and non-scheduled flights,
- airspace availability or constraints,
- available capacity of ATM resources and the impact of operational changes (new procedures, new standards, etc);
- ATM and airport facilities availability,
- estimates on weather conditions; and
- estimates of other non-forecast airspace users' demands.

2. This data can be used to aid the airspace organization and management processes to obtain strategic demand and capacity balancing by adjusting capacity in advance. The main benefit through using electronic data in a strategic phase is improved processes, developing from a tactical or reactive system to a strategic or proactive one, in which predictability is improved and allowing the maximum flexibility and economy of operations for users in normal conditions.

3 The strategic ATFM database includes establishing procedures and route structures to maintain or improve safety levels, capacity and efficiency in the use of airspace and runways, and to best suit the traffic flows and to assist traffic separation in line with the different demands on airspace at different times of the day and night.

***Pre-tactical***

4. Implies adjustments to the coordinated strategic plan. During the pre-tactical phase, data received from all users and service providers -- such as confirmations, modifications, cancellations and additions -- must be analyzed and incorporated. The data should:

- be progressively refined and expanded, taking into account user preferences for flexibility, punctuality or service quality requirements;
- provide a framework that gives a good forecast of the traffic demand and the users' capabilities and resolves conflicts of interest between those parties and user groups that plan their activities up to years in advance;
- estimate the reserve capacity and airspace needed for those airspace users who, due to the tactical nature of their operations, cannot plan far in advance;
- set the rules and parameters, which broadly outline everyone's access to airspace, routes and airports; and
- provide estimates on the reserve capacity that may be needed for each day's traffic situations.

5. The pre-tactical data refers to statements of proposed flight plan, airspace regimes and reservations, route configuration and service provider limitations, capabilities and capacities. Normally this data is promulgated on a regional basis, hour-by-hour, at an agreed time before operation.

***Tactical***

6. Involves final tactical modifications. Prior to the flight, users determine the preferred flight trajectory that best addresses their operations and submit the requested trajectory to the demand and capacity balancing service provider for assessment and agreement.

7. This phase examines a flight request to determine if it is acceptable or if there are any potential resource, capacity or congestion problems of which the user is unaware. If there are problems, demand and capacity balancing identifies user-preferred solutions, giving the freedom to choose the most optimum flight within the system constraints. In this phase, real-time information exchange is required, such as:

- weather forecasts;
- current traffic demand and airspace reservations;
- predictability on a continuous basis of airport and airspace capacity and traffic densities for the entire day;
- updated information, hour-by-hour, on forecast capacity constraints throughout areas and/or routes; and,
- assessment of the impact on the complete flight trajectory, i.e. gate-to-gate.

8. Other interested parties who might need electronic information to improve the service that they supply or receive will benefit from more accurate arrival, departure and current flight trajectory information include: customs and immigration authorities, meteorology departments, baggage handling, airport authorities and aircraft operators (refueling times, parking bays, etc.).

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**APPENDIX C**

**ATFM Strategy for Cricket World Cup**

- Identify key stakeholders (ATC service providers and users, military authorities, airport authorities, aircraft operators and relevant international organisations) for purposes of coordination and cooperation, using a CDM process;
    - ATC service providers
        - ACC/ARTCC
        - Towers
    - Airport authorities
    - Customers
        - Air carrier, IATA, and IFALPA
        - Air taxi
        - Air Cargo
        - General aviation and IBAC
        - Military
        - Other

***Target completion date: October 2006***

- Identify and analyse traffic flow problems and develop methods for improving efficiencies on gradual basis, as needed, through enhancements in current:
    - airspace organization and management (AOM) and airway structure (unidirectional routes),
    - communications and surveillance systems,
    - aerodrome capacity,
    - ATS capacity, and
    - ATS letters of agreement;
    - Coordinate with the POCs to identify specific traffic flows between the NAM and CAR regions that require the application of ATFM procedures

      ***Target completion date: October 2006***

    - Coordinate with ATC service providers and airport authorities to establish airport acceptance rates (AAR) at key airports in the NAM/CAR regions where this metric has not been defined

      ***Target completion date: March 2007***

    - Coordinate with the POCs to improve the airway structure in the NAM/CAR regions

    - Coordinate with all parties concerned to improve radio and navigational communications and radar surveillance in the NAM/CAR regions

      ***Target completion date: Sep 2008***

- Identify on-going regional traffic flow problems and develop methods for improving efficiency on an as needed, graduated basis

    - Coordinate with the POCs to identify the key traffic flows in the NAM and CAR regions that can benefit from ATFM procedures

***Target completion date: October 2006***

- Define common elements of situational awareness between FMUs;

    - common traffic displays,
    - common weather displays (Internet),
    - communications (teleconferences, web), and
    - daily teleconference/messages advisories
    - Coordinate with the FAA/ATCSCC and DGAC concerned to complete the installation of ETMS or similar system, as required

***Target completion date: December 2006***

    - Coordinate with the FAA/ATCSCC and NAM/CAR regional ATC service providers to explore the concept of establishing a regional weather data display

***Target completion date: March 2007***

    - Coordinate with the FAA/ATCSCC, and POCs to establish a once-a-day telephone conference to be used for regional ATFM planning measures

***Target completion date: November 2006***

- Develop methods to establish demand and capacity forecasting

    - Coordinate between parties concerned to develop a method for determining:

        - Airport acceptance rate
        - Sector capacity
        - Sector monitor alert parameters

***Target completion date: March 2007***

- Develop a regional strategy and work programme for implementation of ATFM in the ECAR
        - Coordinate with the FAA/ATCSCC and ACCs to prepare Draft NAM/CAR Regional ATFM Concept of Operations

***Target completion date: November 2006***

- ATFM Procedural Manual

  ***Target completion date: March 2007***

- Training programme

  ***Target completion date: March 2007***

- Monitor implementation progress

  ***Target completion date: December 2006 and March 2007***

## APPENDIX D

## REGIONAL OPERATIONS PLAN (ROP).

The need for air traffic flow management drives demand at major aerodromes as well as demand in the en route environment.

Meteorological conditions affect both aerodrome and en route operations, placing strains on the system which are most effectively dealt with through ATFM initiatives.

The ANS providers must work together to manage traffic demand in airspace. These partnerships should also provide customers with more efficient routings and altitudes by taking into account forecast weather, minimum time tracks, and demand.

The regional implementation of ATFM service includes development of a Regional Operations Plan (ROP) with the purpose to establish a process, structure, and identify responsibilities that will be coordinated through daily teleconferences and advisories to manage demand and capacity balancing.

The Regional Operations Plan (ROP).

The ROP will be a collaboratively developed plan derived from discussion between ANS points of contact (POCs), weather forecasters and customer representatives. Other participants may be included in the process as necessary, including military representatives, aerodrome representatives, and technical representatives.

a) The ROP will normally be developed:

- For one day at a time; and
- For the twelve (12) hour period following a morning Planning Telephone Conference (Planning TELCON), utilizing agreed upon weather products.

b) The ROP will specify:

1. Aerodrome constraints - Facilities where delays are expected to reach 15 minutes or greater.
2. En route constraints - Facilities where expanded miles-in-trail, expanded minutes-in-trail, en route deviations, or tactical reroutes may be required.

c) ANS POCs will:

1. Participate via a daily Planning TELCON in the formulation and development of the ROP.
2. Provide input on:
   i. Aerodrome constraints - for example, include aerodrome acceptance rate (AAR) information when arrival delays are anticipated at a particular aerodrome.
   ii. En route constraints - for example, include the impact of thunderstorm and hurricane activity and route closures.
   iii. Equipment outages - for example, include radar and sector frequency outages that have an operational impact.

iv. Other issues that may have an impact on operations - examples include: staffing, special events, volcanic activity.
v. Anticipated traffic management initiatives that will be used to manage regional traffic.

3. Coordinate with and provide direction to their air traffic facilities on implementation of the ROP.

d) Hosting Air Traffic Flow Management Unit

1. Maintain a Planning TELCON bridge.
2. Maintain a web page for publishing the ROP to aviation system customers.
3. Lead the Planning TELCON and facilitate the development of the ROP.
4. Record the list of participants on the Planning TELCON.
5. Post the ROP on the designated web page.
6. Coordinate the transmission of the ROP as a numbered advisory.
7. Coordinate with and provide direction to appropriate air traffic facilities on implementation of the ROP.

e) Planning TELCON preparation checklist

1. Review the weather products
2. Obtain input from ACCs
   i. Constraints
   ii. Anticipated traffic volume
   iii. Anticipated traffic management initiatives
   iv. Staffing
   v. Equipment outages
   vi. Other
3. Obtain input from Aerodromes
   i. Aerodrome configuration and acceptance rate
   ii. Constraints
   iii. Anticipated traffic volume
   iv. Anticipated traffic management initiatives
   v. Staffing
   vi. Equipment outages
   vii. Other
4. Miscellaneous
   i. Special events
   ii. Military activities
   iii. Volcanic activity

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## APPENDIX E

### Demand and Capacity Balancing (DCB) Management

Capacity is the maximum number of flights which can be handled gate-to-gate and can be measured daily, monthly and/or annually in order to monitor system performance in an effective manner for:

- Airport arrival acceptance rate
- Terminal and en route maximum number of flights in sector/FIR

The purpose of DCB management is to establish sufficient capacity to provide service for both normal and peak traffic levels. By analyzing demand and capacity, measures can be identified to increase capacity where needed. The responsible ATS authority shall ensure that agreed safety levels are not jeopardized during introduction of any changes to the system.

When all the agreed requirements are adequately covered, the service capacity is 100%. The latter reduces when said requirements are restricted in their operation. As more restrictions are placed on resources, a corresponding reduction in service capacity occurs.

A record of all aspects concerning the declared capacity should be carried out in order to be able to determine when it is reduced or needs to be increased. The responsible ATS authority shall ensure that agreed safety levels are not jeopardized.

Among the most important DCB management aspects are the following:

**ATS capacity** - In order to attain maximum efficiency, the following aspects should be analyzed:

- Airspace and route structure - the operation of all types of aircraft foreseen with the user's preferred profiles, the final objective of which is to attain a dynamic and flexible use of airspace.
- High and low sectors, TMAs, restrictions, etc.
- Available infrastructure and navigation accuracy of the aircraft using the airspace and routes with regard to agreed regional air navigation requirements
- ATC workload
- Weather factors

**Airport capacity** - The development and establishment of a master plan aimed at optimizing the available airport capacity should be fostered. The future service requirements should also be studied with regard to the following aspects:

- Runway and taxiway
- Airport efficiency (timing use of runways, taxiways, and ramps) delays, restrictions, SLOTS, etc.
- Airport acceptance rate: considering additional services such as ramp, immigration, custom, and others related to:
    - VFR operations
    - IFR operations

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## APPENDIX F

## Basic Criteria to Assess ATC Workload

An analysis of ATC workload should be carried out with the following considerations:

- Average operations volume
- Short and medium term traffic growth (2010/2015)
- Personnel increases and decreases, upon operational justification
- Average traffic growth last 6 months
- Increase one ATCO when the total rate is higher than 50%
- Determine required personnel to cover regular days off, vacation periods and similar absences
- Justify changes for other factors e.g. overtime, contingencies, etc.
- Adequately cover positions in accordance with ATS unit purposes
- Analyse traffic volume, especially peak periods during the shift
- Avoid affecting service
- Ensure equitable distribution of workload
- ATCOS available during shift
- Average operations that ATC personnel (ACC) may handle in one shift (e.g. 8 Hrs)

**E.g. RADAR Duties**

| | | | |
|---|---|---|---|
| Tc | = | COMMUNICATION TRANSFER | 30” |
| COM | = | COMMUNICATION (INSTRUCTIONS) | 75” |
| C | = | SEPARATION | 45” |
| | | | 150” |

$$C = \frac{3600}{TC+COM+S} = \frac{3600}{150} = 24 \text{ OPS/h}$$

24 OPS X 8 = 192

Average number of operations that ATC personnel (ACC) may handle in one shift (e.g. 8 Hrs)

**NON RADAR duties**

| | | |
|---|---|---|
| COR | = | COORDINATION |
| CO | = | COMMUNICATION |
| S | = | SEPARATION |
| TCO | = | COMMUNICATION TRANSFER |

$$C = \frac{3600}{COR+CO+S+TCO} = \frac{3600}{240} = 15 \text{ OPS/h} : 105$$

**ATC Sector Capacity**

$$C = \frac{3600}{TFC}$$

| | | |
|---|---|---|
| C | - | Capacity |
| TPS | - | Average flight time in sector |
| TFC | - | Average time performing ATC duties (Transferring Control, Communication, Separation) |

**Planning Requirements for ATM Human Resources**

In accordance with NACC/DCA meetings, directives and upon specific operational requirements, whenever possible, the following requirements for ATM human resources planning should be analyzed:

- Air Traffic Controller - TWR
- Air Traffic Controller - APP
- Air Traffic Controller - Area
- Air Traffic Controller – Radar/APP
- Air Traffic Controller  Radar/Area
- ATC Operational Supervisor
- ATFM coordinator
- ATC/OJT Instructor
- ATS Airspace Planning Officer
- ATS Regulations Officer
- ATM Quality Assurance Officer and Safety Officer
- ATM Internal Auditor Officer

ATM human resources planning should also consider:

1. Number of operations (VFR/IFR);

2. ATC service management required in airspace sectors;

3. The impact of new implementations and technical communication improvements (CPDLC, ADS, etc.) on ATC workload;

4. The ATCO workload should not exceed 80% of individual capacity during the shift’s peak hour;

5. Additional activities such as updating flight plan data, coordination, transfers or a combination of these;

6. Individual ATCO capacity may be increased up to 100% with an assistant;

7. The total number of ATS personnel should be calculated annually considering vacation periods, other anticipated absences, training time and related variables;

8. The operational capacity should address additional aspects for personnel time (planning, organization, supervision, administration);

9. The larger the facility, the more precise these calculations should be; and

10. Once the number of human resources has been assessed the unused capacity should be seen as reserve to cover emerging cases when capacity increases are required.

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