International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)
Fourteenth meeting of the CAR/SAM Regional Planning and Implementation Group (GREPECAS/14)
(San Jose, Costa Rica, 16 to 20 April 2007)

Agenda Item 3: Assessment of development of regional air navigation and security infrastructure

3.6 Report of the ATM/CNS/SG/5 meeting

REPORT OF THE FIFTH MEETING OF THE ATM COMMITTEE

(Presented by the President of the ATM Committee)

SUMMARY

This working paper contains a summary of the outcome of the Fifth Meeting of the ATM Committee, which adopted a series of draft conclusions that are being submitted to the consideration of the GREPECAS/14 meeting.

References:

- Report of the ATM/CNS/SG/5 meeting.
- Report of the AP/ATM/12 meeting.

1. Introduction

1.1 The ATM Committee reviewed the work done by the CAR/SAM Regional Monitoring Agency (CARSAMMA) and the Scrutiny Group (GDE) regarding the safety assessment one year after the implementation of the RVSM in the CAR/SAM Regions, as well as the reports on large height deviations (LHD). It also reviewed the work of the various ATM Committee Task Forces, and aspects related to ATS contingency plans.

1.2 It also analysed the amendment to the Global air navigation plan for CNS/ATM systems (Doc 9750) and its relationship with, and impact on, regional plans and, specifically, the plan for the transition to CNS/ATM systems in the CAR/SAM Regions. The Committee reviewed the ATM and SAR deficiencies and outstanding GREPECAS conclusions/decisions, the work programme of the Committee, and, finally, other matters submitted for discussion during the meeting.

1.3 A summary follows of the work done by the ATM Committee, which formulated ten (10) draft conclusions, as shown in **Appendix A** to this working paper.

2. Work done by the ATM Committee

2.1 Operational use of RVSM in the CAR/SAM Regions

Safety assessment following RVSM implementation in the CAR/SAM Regions

2.1.1 It may be recalled that RVSM was implemented in CAR/SAM airspace on 20 January 2005. CARSAMMA conducted the post-implementation safety assessment after one year of operations. The complete report of this assessment is contained in the report of the AP/ATM/12 meeting, which can be found in the website of the South American Regional Office **www.lima.icao.int**.

2.1.2 The assessment took into account the technical risk plus the risk from all other causes, and shows that the total risk for the CAR/SAM Regions is higher than the agreed TLS. It should be noted that large height deviations (LHDs) have a significant impact on total risk. Errors are not caused by RVSM operation, but rather by common aircraft handover procedures from one ATC unit to another. Therefore, new corrective action was proposed as short- and medium-term solutions. These measures supplement those contained in Conclusion 13/61 and appear in the report of the fifth meeting of the ATM Committee (ATM/COMM/5).

2.1.3 In order to drastically and significantly reduce the occurrence of this type of error, CAR/SAM States/Territories/International Organisations should commit themselves to the adoption, as a matter of urgency, of the measures contained in GREPECAS Conclusion 13/61 *"Measures to reduce operational errors in the ATC coordination loop between adjacent ACCs"* and, in particular, the Programme for the prevention of ATC coordination errors between adjacent ATS units, associated to the cited conclusion.

Safety monitoring in RVSM airspace

2.1.4 Taking into account the need for a new safety assessment of RVSM operations in the CAR/SAM Regions using the collision risk model, a new data collection on air traffic movement was carried out on 15-19 January 2007.

Training of GTE members

2.1.5 The meeting deemed it advisable to conduct training sessions for experts in air traffic management or flight operations so that they can participate in the GTE on a permanent basis. In this respect, the meeting adopted **Draft Conclusion 5/1 - Training in large height deviation (LHD) analysis**.

2.2 **Performance-based navigation (PBN)**

CAR/SAM performance-based navigation (PBN) roadmap

2.2.1.1 The meeting noted that, in order to plan and implement performance-based navigation, detailed information was needed on several aspects related to CNS infrastructure and the navigation capability of the fleet operating in the CAR/SAM Regions. Consequently, an RNAV and RNP questionnaire was developed and used to prepare a roadmap, which was considered to be a fundamental document for the harmonisation of PBN implementation in the CAR/SAM Regions.

2.2.1.2 As a result of this analysis, the meeting established a short-term (until 2010) and a medium-term (2011-2015) implementation strategy, contained in the PBN roadmap, which appears in **Appendix B** to this working paper.

2.2.1.3 In light of the above, the meeting approved **Draft Conclusion 5/2-CAR/SAM Performance-based Navigation (PBN) Roadmap.**

RNAV and RNP training requirements

2.2.1.4 In this respect, it has been deemed advisable that the States and International Organisations that have courses on topics such as airspace planning, design of PANS/OPS procedures, and safety assessment, make them available to the other States and International Organisations, and that all available reference material be posted on the websites of the ICAO Regional Offices.

Aircraft operations and airworthiness

2.2.1.5 A review was made of information on PBN and its two categories, RNAV and RNP, and also of the guides and directives for ACC inspectors on the approval process for the following types of operations: RNP 10, RNP 4, RNAV 5; RNAV 2 and RNAV 1. These documents appear in the report of the AP/ATM/12 meeting, and are posted on the website of the South American Regional Office **www.lima.icao.int.**

Safety assessment seminars and methodology

2.2.1.6 In order to implement the PBN concept in a harmonious manner, a safety assessment of different parts of the airspace will be required, applying different methodologies. It was also felt that there was a limited number of professionals involved in the area of safety assessment. It was also noted that there was no common methodology for terminal area safety assessments, understanding that the Separation and Airspace Safety Panel could address this issue. In view of the above, the meeting formulated **Draft Conclusion 5/3-Safety assessment seminars and methodology**.

Operational errors in a PBN environment

2.2.1.7 It is obvious that, with RNP, there is a close connection between the criteria for the design of en-route and terminal area operational procedures and airspace, and the assurance that only those aircraft, systems and operators with certified performance are authorised to conduct operations. Altogether, aircraft certification and operator approval requirements represent a specific safety aspect that needs to be addressed and approved.

2.2.1.8 Consequently, the meeting considered that the guidance and operational criteria developed by the ATM Committee at its fifth meeting should be taken into account when developing risk analysis requirements and national regulations for PBN approval of aircraft and operators. In this sense, the meeting approved **Draft Conclusion 5/4-Importance of operational errors in a PBN environment**.

2.2.2 **Air traffic flow management (ATFM)**

2.2.2.1 The meeting agreed that ATFM implementation should be done by phases in order to allow for a gradual evolution and develop system capabilities, following strategic, pre-tactical and tactical phases.

2.2.2.2 To the extent possible, the airspace should be structured free of operational discontinuities, inconsistencies, and differing standards and procedures. Likewise, the alignment of airspace classifications should be encouraged, data link communications developed and used to a larger extent, flight plan processing improved, and ATFM message exchange capabilities developed.

2.2.2.3 In order to improve the efficiency of air operations, the meeting considered that operational agreements between ATS units should be updated or established in the short term, and to that end, it formulated **Draft Conclusion 5/5 - ATFM operational agreements.**

ATFM operational concept in the CAR and SAM Regions (CAR/SAM ATFM CONOPS)

2.2.2.4 The CAR/SAM ATFM operational concept is a high-level document. Its main objective is to define and regulate the homogeneous implementation of ATFM in the CAR/SAM Regions. It should be noted that, although ATFM planning will be done jointly for both Regions, the implementation of the system *per se* will be done in keeping with the needs of each region.

2.2.2.5 In this respect, a single ATFM operational concept for both Regions will permit a harmonised implementation in the regions and will ensure an effective and equitable service. The operational concepts will define the minimum functions and requirements on which the implementation of the service and of the required ATFM units would be based.

2.2.2.6 The meeting analysed the draft ATFM operational concept, which appears in **Appendix C** to this working paper, and considered that said document could be adopted for the CAR/SAM Regions, and thus approved **Draft Conclusion 5/6-Adoption of the ATFM operational concept for the CAR/SAM Regions**.

Cost-benefit analysis

2.2.2.7 On this topic, it was recalled that the Action Plan for the implementation of ATFM, approved by GREPECAS, included Task 1.13 – "Provide information for cost-benefit analysis". It was deemed necessary to encourage CAR/SAM providers, in coordination with the ATFM implementation groups, to use the information material, which appears in Appendix I to Agenda Item 2 of the ATM/COMM/5 Final Report to collect all relevant information, in order to conduct their cost-benefit analysis. Accordingly, it formulated **Draft Conclusion 5/7-Collection of information for the cost-benefit analysis.**

2.2.3 **ATM automation**

2.2.3.1 The Group recognised that various States/Territories/International Organisations had started bilateral conversations to conduct studies and reach agreements for the exchange of flight information among existing automation systems, taking into account the ICD. The meeting agreed that the work on data exchange in the CAR and SAM Regions should continue, specifically among those facilities whose systems were ready and capable of handling the interface.

2.2.3.2 It was agreed that the ICD should be submitted to GREPECAS for approval, and to keep it as an updated evolving document, to be expanded as necessary when new requirements were identified and new technologies implemented. (See **Appendix D** to this working paper).

2.2.3.3 The meeting felt that the best way of achieving a seamless and inter-functional ATS system among the States/Territories/International Organisations was through the establishment of bilateral or multilateral agreements among adjacent ATS units, which would provide guidance for the implementation of CNS/ATM applications wherever feasible and required. As experience is gained from successful implementation, the knowledge, advantages and benefits will be shared among all the parties involved. Therefore, the meeting formulated **Draft Conclusion 5/8-Agreements for the interface of automated systems**.

2.2.3.4 It also agreed that the States/Territories/International Organisations should formulate an action plan based on the performance objective for the interface of ATM automated systems, and approved **Draft Conclusion 5/9-Establishment of an Action Plan for the Interface of ATM automated systems.**

2.3 **ATS contingency plans**

2.3.1 It was noted that the Air Navigation Commission had congratulated GREPECAS for developing a Plan for drafting ATS contingency plans. Also, considering that Conclusion 13/68 was consistent with Strategic Objective E: *Continuity – Maintain the continuity of aviation operations*, it requested GREPECAS to prepare a regional catalogue of ATS contingency plans to support compliance with the cited Strategic Objective.

2.3.2 It was noted that some CAR/SAM States had already harmonised their respective ATS contingency plans according to Attachment D to Annex 11, and that others were in the process of preparing them, but that would not hinder the development of a regional catalogue to be presented at the GREPECAS/14 meeting. Consequently, the meeting reviewed and approved the Regional Catalogue model, which appears in **Appendix E** to this working paper, and formulated **Draft Conclusion 5/10- Catalogue of CAR/SAM ATS contingency plans.**

2.4 Review of ATM and SAR deficiencies and outstanding GREPECAS Conclusions/Decisions (Task ATM-GRAL/100)

Review of ATM and SAR deficiencies

2.4.1 The meeting took note of the updated information on ATM and SAR deficiencies with "A","B" and "U" priority in CAR/SAM States, Territories, and International Organisations, as well as of their action plans to correct them. It recalled Conclusion 13/92 whereby GREPECAS had requested CAR/SAM States, Territories, and International Organisations to make their utmost to eliminate all urgent deficiencies by December 2007.

Review of outstanding Conclusions/Decisions from previous GREPECAS meetings

2.4.2 According to the GREPECAS Procedural Manual, the Conclusions and Decisions were analysed in order to keep them updated and reduce them to the minimum, based on the progress made. The Conclusions/Decisions on ATM and SAR are shown in WP/20.

2.5 Plan for the transition to the ATM system in the CAR/SAM Regions

2.5.1 The meeting recalled that the Air Navigation Commission, on 17 January 2006, had studied a second proposal of amendment to the Global air navigation plan for CNS/ATM systems (Doc 9750) (Global plan), whereby the Global Plan Initiatives (GPIs) were incorporated. These initiatives will be inserted into the existing planning work programme of the Regional Planning and Implementation Groups (PIRGs). Global initiatives are designed to contribute to the achievement of regional performance objectives and to support regional implementation programmes, which should be developed based on well-identified performance objectives.

2.5.2 The Plan for the transition to the ATM system in the CAR/SAM Regions has been developed taking into account the Global Air Navigation Plan. Its purpose is to apply the Global Plan Initiatives (GPI), in order to begin the transition towards the ATM operational concept, and to fully update the CAR/SAM Regional Plan for the implementation of ATM/CNS systems.

2.5.3 The specific chapters related to the navigation infrastructure and institutional aspects should be developed by the AGA/AOP, AIS, HRT, and MET Subgroups, the CNS Committee, and the Institutional Aspects Task Force, taking into account the operational requirements established in chapter 4, the guides of the GPIs involved, and the introduction to each of the specific chapters, based on those ATM operational requirements.

2.5.4 In view of the above, the ATM/CNS SG analysed the Plan for the transition to the ATM system in the CAR/SAM Regions, and proposed some changes that it deemed necessary. Additional information may be found in the report on Agenda Item 4 of the ATM/CNS/SG/5 meeting.

2.6 **Organisational issues of the ATM Committee**

2.6.1 The meeting reviewed the Terms of Reference and Work Plans of each of its working groups, as shown under item 5.2.

2.7 **Other matters**

2.7.1 Under this topic, the meeting took note that the United States had started to coordinate plans and requirements for redesigning the airspace and reducing the lateral separation in the *"West Atlantic Route System"*, including the oceanic airspace of the Miami Centre and of the San Juan Centre Flight Information Region (FIR) (*"WATRS-Plus" airspace*). This initiative will increase airspace capacity, give air traffic service providers more flexibility, and allow users a more efficient operation.

3. **Suggested action**

3.1 The Meeting is invited to take note of the information provided concerning the Fifth Meeting of the ATM Committee of the ATM/CNS Subgroup, and approve the draft conclusions shown in **Appendix A** to this working paper.

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APPENDIX A

DRAFT CONCLUSIONS ADOPTED DURING ATM/COMM/5 MEETING, TO BE SUBMITTED FOR CONSIDERATION OF GREPECAS

DRAFT
CONCLUSION 5/1 **TRAINING ON THE ANALYSIS OF LARGE HEIGHT DEVIATIONS (LHD)**

That, taking into account the need to have qualified experts available to assist in the activities of the GTE, the CAR and SAM States/Territories/International Organizations:

a) support training on analysis of Large Height Deviations as part of regional activities;

b) send technical experts to the training sessions envisaging those experts becoming regular participants of the GTE; and

c) that ICAO take the necessary actions to coordinate GTE training sessions in each Region.

DRAFT
CONCLUSION 5/2 **CAR/SAM ROADMAP FOR PBN**

That States/Territories and International Organizations adopt and apply the CAR/SAM Roadmap for PBN as shown in **Appendix XX** to this part of the report.

DRAFT
CONCLUSION 5/3 **SAFETY ASSESSMENT SEMINARS AND METHODOLOGY**

That ICAO:

a) promote seminars related to safety assessments, aiming at the preparation of personnel to work in the future PBN implementation;

b) encourage safety airspace and separation panel (SASP) to develop a common methodology for safety assessment in terminal areas.

DRAFT
CONCLUSION 5/4 IMPORTANCE OF OPERATIONAL ERRORS IN A PBN ENVIRONMENT

States, Territories and International Organizations analyze the importance of operational errors in an environment with PBN and invest all possible resources in the training of air traffic controllers and pilots aiming the reduction of these errors considering the future implementation of this concept in the CAR/SAM Regions.

DRAFT
CONCLUSION 5/5 ATFM OPERATIONAL AGREEMENTS

That CAR and SAM States/Territories/International Organizations, which so require and that have not done so, when reviewing operational bilateral agreements among ATS units include balance measures between demand and capacity not later than **30 November 2007**.

DRAFT
CONCLUSION 5/6 ADOPTION OF THE CAR AND SAM ATFM CONCEPT OF OPERATIONS (ATFM CAR/SAM CONOPS)

That the CAR and SAM States/Territories and International Organizations:

a) adopt the CAR and SAM ATFM Concept of Operations (ATFM CONOPS) shown in **Appendix XX** to this part of the report; and

b) establish a work program to enable the implementation of the ATFM CONOPS.

DRAFT
CONCLUSION 5/7 COLLECTION OF INFORMATION FOR THE COST-BENEFIT ANALYSIS

That CAR/SAM States/Territories/International Organizations which have not yet done so, initiate the data collection to develop its financial cost-benefit analysis of the ATFM implementation project, using as guidance material the information shown in **Appendix I** to Agenda Item 2 of the ATM/COMM/5 Report.

DRAFT
CONCLUSION 5/8 **AGREEMENTS FOR ATM AUTOMATED SYSTEMS INTERFACE**

That CAR/SAM States/Territories/International Organizations:

a) take into account technical feasibility studies and operational benefits, and coordinate the establishment of bilateral and multilateral agreements for the interface of automated systems between adjacent units; and

b) use guidance material specified as "Interface Control Document (ICD) for data communications between ATM units in the CAR and SAM Regions", included in **Appendix XX** to this part of the report, keeping in mind that:

i) ICAO guidance material contained in such document is applicable at the regional level; and

ii) material that does not comply with ICAO guidelines, should be used only as reference and would be agreed at a bilateral or multilateral basis, as required.

DRAFT
CONCLUSION 5/9 **ESTABLISHMENT OF AN ACTION PLAN FOR THE INTERFACE OF ATM AUTOMATED SYSTEMS**

That CAR/SAM States/Territories/International Organizations, formulate an Action Plan for the interface of ATM automated systems, which includes:

a) the assignment of an expert as point of contact to carry out the regional coordination work for the interface of ATM automated systems;

b) the analysis of the current service level provided by ATS automated systems, as well as requirements to satisfy future operational applications of the ATM community using the Table of ATS Operational Requirements for Automated Systems, included in **Appendix O** to Agenda Item 2 of the ATM/COMM/5 Report.

c) document the action plan and share practices and experiences with other States/Territories/International Organization, which so require.

DRAFT
CONCLUSION 5/10 **CATALOGUE OF CAR/SAM ATS CONTINGENCY PLANS**

That:

a) the Catalogue of CAR/SAM ATS contingency plans, shown in **Appendix XX** to this part of the report, is adopted; and

b) CAR/SAM States/Territories/International Organization send the updated information to ICAO, before 1st July 2007, for its inclusion in said document.

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APPENDIX B

PBNRM

INTERNATIONAL CIVIL AVIATION ORGANIZATION

North American, Central American and Caribbean (NACC) Regional Office

South American (SAM) Regional Office

CAR/SAM ROADMAP FOR PERFORMANCE-BASED NAVIGATION

(Lima, November 2006)

Draft Version 1.2

Table of Contents

1. EXECUTIVE SUMMARY

1.1. Following RVSM implementation on 20 January 2005, the main tool for optimising the airspace structure is the implementation of performance-based navigation (PBN), which will foster the necessary conditions for the utilisation of RNAV and RNP capabilities by a significant portion of airspace users in the CAR/SAM Regions.

1.2. In view of the need for detailed navigation planning, it was deemed advisable to prepare a PBN Roadmap to provide proper guidance to air navigation service providers, airspace operators and users, regulating agencies, and international organisations, on the evolution of navigation, as one of the key systems supporting air traffic management, which describes the RNAV and RNP navigation applications that should be implemented in the short, medium and long term in the CAR/SAM Regions.

1.3. The CAR/SAM PBN Roadmap was developed by the CAR/SAM States and International Organizations, together with the international organizations concerned (IATA, IFALPA, IFATCA), and is intended to assist the main stakeholders of the aviation community plan the future transition and their investment strategies.

1.4. The CAR/SAM PBN Roadmap will be the basic material for the development of a broader CAR/SAM navigation strategy, which will serve as guidance for regional projects for the implementation of air navigation infrastructure, such as SBAS, GBAS, etc., as well as for the development of national implementation plans.

1.5. This document begins with a brief description of the need for a roadmap, the strategic objectives of the document, and the principles on which the implementation will be based. It should be noted that, during the transition period, conventional air navigation procedures would continue to be applied in order to safeguard the operations of users that are not RNAV- and/or RNP-equipped.

1.6. It then explains the PBN implementation strategy for both en-route and terminal area operations. It also analyses briefly the PBN concept, and lists the benefits of implementing this concept.

1.7. A review is made of data concerning the regular traffic of passengers on CAR/SAM airlines during the 1994-2004 period, CAR/SAM traffic forecasts, and traffic trends up to the year 2015.

1.8. It furthermore defines the implementation of performance-based navigation in the short, medium, and long term with respect to en-route operations, TMA operations (SIDs and STARs), and IFR approaches, broadly establishing the requirements and specifications for each stage.

1.9. A description is made of RNAV/RNP approval, which will encompass two types of approvals: airworthiness, exclusively relating to the approval of aircraft; and operational, dealing with the operational aspects of the operator. RNAV/RNP approval will be granted to operators that comply with these two types of approvals.

1.10. The implementation of the performance based navigation forecast significant safety-related changes in the airspace structure as well as to the ATC system. The ICAO requirement for new operations introduced post 2000 is that the risk of collision has to be less than 5 than $5x10^{-9}$ per dimension.

1.11. After the implementation of PBN applications and the airspace concept, the total system needs to be monitored to ensure that the safety of the system is maintained. A System Safety Assessment is conducted after implementation and evidence collected to ensure that the safety of the system is assured.

2. EXPLANATION OF TERMS

2.1 The drafting and explanation of this document is based on the understanding of some particular terms and expressions that are described below:

CAR/SAM PBN Roadmap. Document offering appropriate guidance for air navigation service providers, airspace operators and users, regulating agencies, and international organizations, on the evolution of navigation, as one of the key systems supporting air traffic management, which describes the RNAV and RNP navigation applications that should be implemented in the short, medium and long term in the CAR/SAM Regions.

Performance Based Navigation. Performance based navigation specifies RNAV system performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in an airspace.

Performance requirements. Performance requirements are defined in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept. Performance requirements are identified in navigation specifications which also identify which navigation sensors and equipment may be used to meet the performance requirement.

3. ACRONYMS

3.1 Lista de Acrónimos/ List of Acronyms

ADS/B	Vigilancia dependiente automatica-radiodifusión Automatic dependent surveillance-broadcasting
ADS/C	Vigilancia dependiente automática-contrato Automatic dependent surveillance-contract
ANS	Servicios de navegación aérea Air navigation services
ANSP	Proveedores de Servicios de Navegación Aérea/Air Navigation Service Providers
ASM	Gestión del espacio aéreo/ Airspace Management
ATC	Control de tránsito aéreo/ Air Traffic Control
ATFM	Gestión de afluencia del tránsito aéreo/ Air Traffic Flow Management
ATM	Gestión del tránsito aéreo/ Air Traffic Management
ATN	Red de telecomunicaciones aeronáuticas/ Aeronautical Telecommunication Network
ATS	Servicio de tránsito aéreo/ Air Traffic Services
CAR/SAM	Regiones Caribe y Sudamérica/Caribbean/South American Regions
CNS/ATM	Comunicaciones, navegación y vigilancia/Gestión del tránsito aéreo/ Communications, Navigation and Surveillance/Air Traffic Management
CPDLC	Comunicaciones por enlace de datos controlador-piloto /Controller-Pilot Data Link Communications
CTA	Area de control /Control Area
DME	Equipo Radiotelemetrico/Distance-Measuring Equipment
FAR	Regulación federal de aviación/Federal Aviation Regulation
FANS-1/A	Sistemas de navegación aérea del futuro – Aviónica/ Future Air Navigation Systems - Avionics
FDE	Detección y eliminación de fallas / Fault Detection and Exclusion
FIR	Región de información de vuelo /Flight Information Region
FMS	Sistema de gestión de vuelo /Flight Management System
GBAS	Sistema de Aumentación con Base en Tierra/Ground-Based Augmentation System
GLS	Sistema de aterrizaje GBAS / GBAS Landing System
GNE	Error de navegación grave / Gross Navigation Error
GNSS	Sistema mundial de navegación por satélite / Global Navigation Satellite System
GPMS	Sistema de monitoreo de la performance del GPS / GPS Performance Monitoring System
GREPECAS	Grupo Regional de Planificación y Ejecución CAR/SAM/ CAR/SAM Regional Planning and Implementation Group
GRAS	Sistema de Aumentación Terrestre Regional / Ground Regional Augmentation System
HF	Alta frecuencia/ High Frequency
IATA	Asociación del Transporte Aéreo Internacional/ Internacional Air Transport Association
ICD	Documento de control de interfaz / Interface Control Document
IFALPA	Federación Internacional de Asociaciones de Pilotos de Líneas Aéreas/International Federation of Air Line Pilots' Associations
IFATCA	Federación Internacional de Asociaciones de Controladores de Tránsito Aéreo/International Federation of Air Traffic Controllers' Associations
IRU/INS	Unidad de referencia inercial/Sistema de navegación inercial/ Inertial Reference Unit/Inertial Navigation System
JAA	Autoridades Conjuntas de Aviación Civil/Joint Aviation Authorities

JAR	Regulaciones Conjuntas de Aviación Civil/Joint Aviation Regulations
NAT	Atlántico septentrional /North Atlantic
NDB	Radiofaro no direccional /Non-Directional Beacon
NOTAM	Aviso al Personal Encargado de las Operaciones de Vuelo/Notice to Airmen
PBN	Navegación Basada en la Performance /Performance-Based Navigation
RNAV	Navegación de área/Area Navigation - RNAV Route: Ruta de navegación de área/Area navigation route
RNP	Performance de navegación requerida /Required Navigation Performance
RNP AR	Requerimiento de aprobación para la performance de navegación requerida/ Required Navigation Performance Aproval Required
RNPC	Capacidad de la performance requerida de navegación/Required navigation performance capacity
RNPSORSG	Grupo de Estudio sobre RNP y Requerimientos Operacionales Especiales/RNP and Special Operational Requirements Study Group
SARPS	Normas y métodos recomendados (ICAO)/ Standards and Recommended Practices (ICAO)
SATCOM	Comunicaciones por satélite/Satellite Communications
SBAS	Sistema de Aumentación de Base Satelital/Satellite-based Augmentation System
SID	Salida Normalizada por Instrumentos/Standard Instrument Departure
SSR	Radar secundario de vigilancia/Secondary Surveillance Radar
STAR	Llegada Normalizada por Instrumentos/Standard Instrument Arrival
TLS	Nivel de seguridad deseado/Target Level of Safety
TMA	Area Terminal/Terminal Area
VHF	Muy alta frecuencia /Very High Frequency
VDL	Enlace de datos en VHF/ VHF Data Link
VOR/DME	Radiofaro omnidireccional VHF/Equipo radiotelemétrico/Very High Frequency Omnidirectional Radio Range/Distance-Measuring Equipment

4. INTRODUCTION

Need for a roadmap

4.1 Following RVSM implementation on 20 January 2005, the main tool for optimising the airspace structure is the implementation of performance-based navigation (PBN), which will foster the necessary conditions for the utilisation of RNAV and RNP capabilities by a significant portion of airspace users in the CAR/SAM Regions.

4.2 Current planning by the Regional Planning and Implementation Groups is based on the Air Navigation Plans and the Regional CNS/ATM Plans. Currently, these plans are mostly made up by tables that do not contain the necessary details for the implementation of each of the CNS and ATM elements.

4.3 In view of the need for detailed navigation planning, it was deemed advisable to prepare a PBN Roadmap to provide proper guidance to air navigation service providers, airspace operators and users, regulating agencies, and international organisations, on the evolution of navigation, as one of the key systems supporting air traffic management, which describes the RNAV and RNP navigation applications that should be implemented in the short and medium term in the CAR/SAM Regions.

4.4 Furthermore, the CAR/SAM PBN Roadmap will be the basic material for the development of a broader CAR/SAM navigation strategy, which will serve as guidance for regional projects for the implementation of air navigation infrastructure, such as SBAS, GBAS, etc., as well as for the development of national implementation plans.

Objectives

4.5 The CAR/SAM PBN roadmap has the following strategic objectives:

a) To ensure that the implementation of the navigation item of the CNS/ATM system is based on clearly established operational requirements.
b) To avoid unnecessarily imposing the mandate for multiple equipment on board or multiple systems on ground.
c) To avoid the need for multiple airworthiness and operational approvals for intra- and inter-regional operations.
d) To prevent commercial interests from outdoing ATM operational requirements, generating unnecessary costs for CAR/SAM States and International Organizations, as well as for airspace users.
e) To explain in detail the contents of the CAR/SAM Air Navigation Plan and of the CAR/SAM CNS/ATM Plan, describing potential navigation applications.

4.6 Furthermore, the CAR/SAM PBN Roadmap will provide a high-level strategy for the evolution of the navigation applications to be implemented in the CAR/SAM Regions in the short term (2006-2010), medium term (2011-2015). This strategy is based on the concepts of Area Navigation (RNAV) and Required Navigation Performance (RNP), which will be applied to aircraft operations involving instrument approaches, standard departure (SID) routes, standard arrival (STAR) routes, and ATS routes in oceanic and continental areas.

4.7 The CAR/SAM PBN Roadmap was developed by the CAR/SAM States and International Organizations together with the international organizations concerned (IATA, IFALPA, IFATCA), and is intended to assist the main stakeholders of the aviation community plan a gradual transition to the RNAV and RNP concepts. The main stakeholders of the aviation community that benefit from this roadmap are:

- Airspace operators and users.
- Air navigation service providers.
- Regulating agencies.
- International organizations.

4.8 This roadmap is intended to assist the main stakeholders of the aviation community plan the future transition and their investment strategies. For example, airlines and operators can use this roadmap to plan future equipage and additional navigation capability investments; air navigation service providers can plan a gradual transition for the evolving ground infrastructure. Regulating agencies will be able to anticipate and plan for the criteria that will be needed the future.

Principles

4.9 The implementation of PBN in the CAR/SAM Regions shall be based on the following principles:

a) Conduction of cost-benefit analyses to justify the implementation of the RNAV and/or RNP concepts in each particular airspace;
b) Conduction of pre- and post-implementation safety assessments to ensure the application and maintenance of the established target levels of safety;
c) Development of airspace concepts, applying airspace modelling tools as well as real-time and accelerated simulations, which identify the navigation applications that are compatible with the aforementioned concept.
d) Continued application of conventional air navigation procedures during the transition period, to guarantee the operations by users that are not RNAV- and/or RNP-equipped.

PBN implementation strategy

En-route operations

4.10 It is impossible to include the whole CAR/SAM airspace in a single Implementation Plan for En-Route Operations, since the restructuring of the CAR/SAM airspace for PBN application would become an extremely complicated task.

4.11 Likewise, the establishment of a single RNAV or RNP value for the CAR/SAM Regions is unlikely, bearing in mind the differences in air traffic complexity and movement, as well as the differences in CNS infrastructure, which will probably lead to the application of different airspace concepts in the CAR/SAM Regions.

4.12 Thus, the most appropriate strategy is the implementation of PBN by routing areas in CAR and SAM scenarios, according to their own airspace concepts and infrastructure characteristics, which may involve a group of States/Territories and International Organizations. This implementation strategy will be applied by the States/Territories/International Organizations themselves and will permit the establishment of the RNAV or RNP values for the various areas that will be harmonised within the scope of GREPECAS.

TMA operations

4.13 TMA operations have their own characteristics, taking into account the applicable separation minima between aircraft and between aircraft and obstacles. It also involves the diversity of aircraft, including low-performance aircraft flying in the lower airspace and conducting arrival and departure procedures on the same path or close to the paths of high-performance aircraft.

4.14 In this sense, the States/Territories and International Organizations shall develop their own national plans for the implementation of PBN in TMAs, based on the CAR/SAM PBN Roadmap, seeking the harmonisation of the applicable RNAV and/or RNP criteria to avoid the need for multiple operational approvals for intra- and inter-regional operations, and the applicable aircraft separation criteria that will be soon published by ICAO Headquarters.

5. PBN CONCEPTS

5.1 Performance based navigation specifies RNAV system performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in an airspace.

5.2 Performance requirements are defined in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept. Performance requirements are identified in navigation specifications which also identify which navigation sensors and equipment may be used to meet the performance requirement.

5.3 There are both RNP specifications and RNAV specifications. A RNP specification includes a requirement for onboard performance monitoring and alerting and is designated as a RNP X. A RNAV specification does not have such requirements and is designated as RNAV X.

5.4 Performance based navigation therefore depends on:

- the RNAV system and installation on the aircraft being approved to meet the performance and functional requirements of the navigation specification prescribed for RNAV operations in an airspace; and
- Air crew satisfying the operating requirements set out by the regulator for RNAV operations; and
- A defined airspace concept which includes RNAV operations; and
- an available Navaid infrastructure;

Note: Additional information may be obtained in the Manual XXXX – Performance based navigation.

6. BENEFITS OF PERFORMANCE-BASED NAVIGATION

Performance Based Navigation

6.1 Air traffic growth in the CAR/SAM Regions is foreseen at mid term, at the same time that the economical activity. A growth of 6.2, 5.5 y 5.6, % of regular passenger air traffic of CAR/SAM Regions airlines is foreseen in 2005/2006/2007, respectively, as compared to global growth forecast of 7.6, 6.5 and 6.2%, respectively. At long term, airlines passengers air traffic in the Region is expected to grow at an average of 4.0% until year 2015. This growth may lead to air traffic congestion periods which may guide to ATM lack of efficiency.

6.2 In order to ensure ATM efficiency and avoid unnecessary restrictions to airspace users, specifications should be avoided as to who to satisfy navigation requirements indicating only which is the performance and navigation functionality required from the RNAV system. Under the PBN concept, the generic navigation requirements are defined based on operational requirements. Thus, users may evaluate the available options as regards technology and air navigation services which could permit to satisfy these requirements. The solution elected should be the most cost-effective

6.3 The development of the Performance Based Navigation Concept recognizes that advanced aircraft RNAV systems are achieving a predictable level of navigation performance accuracy which, together with an appropriate level of functionality, allows a more efficient use of available airspace to be realized. It also takes account of the fact that RNAV systems have developed over a 40 year period and as a result there are a large variety of implementations. Identifying navigation requirements rather than on the means of meeting the requirements will allow use of all RNAV systems meeting these requirements irrespective of the means by which these are met.

6.4 The main benefits derived from the implementation of PBN are:

a) Increased airspace safety through the implementation of continuous and stabilised descent procedures that avoid controlled flight into terrain (CFIT);
b) Reduced aircraft flight time due to the implementation of optimal flight paths, with the resulting savings in fuel and environmental protection.
c) Use of the RNAV and/or RNP capabilities that already exist in a significant percentage of the aircraft fleet flying in CAR/SAM airspace.
d) Improved airport and airspace arrival paths in all weather conditions, and the possibility of meeting critical obstacle clearance and environmental requirements through the application of optimised RNAV or RNP paths.
e) Implementation of more precise approach, departure, and arrival paths that will reduce dispersion and will foster smoother traffic flows.
f) Reduced delays in high-density airspaces and airports through the implementation of new parallel routes and new arrival and departure points in TMAs.
g) Possible reduction of spacing between parallel routes to accommodate more traffic in the same flow.
h) Reduced workload for air traffic controllers and pilots due to reduced communications time.

7. IMPLEMENTATION OF PERFORMANCE-BASED NAVIGATION

7.1 ATM operational requirements

7.1.1 The ATM World Plan makes necessary to adopt an airspace concept able to provide and operational scenery that includes Routes Network, Minimum separation, Assessment of obstacles clearance, and CNS infrastructure that satisfies safety specific strategic objectives, capacity, efficiency, environment and technology addressed to the implementation of performance/based navigation.

7.1.2 In this regard, the following programmes will be developed in different areas:

a) traffic and cost benefit studies
b) automation necessary update
c) operations simulation in different sceneries
d) ATC personnel training
e) FPL processing
f) AIS support
g) WGS 84 implementation when necessary
h) uniform classification of adjacent and regional airspaces
i) RNAV/RNP application in SIDs and STARs
j) RNAV routes implementation and coordination

7.2 RNAV/RNP approval will cover to types of approvals: airworthiness, which will exclusively deal with aircrafts approval, and operations, which will take care of the operational aspects of air transport operators. The fulfilment of these types of approvals will permit operators to obtain RNAV/RNP approval.

7.3 **Short term (up to 2010)**

7.3.1 En-route operations

7.3.1.1 Taking into account air traffic low density in oceanic airspaces, no significant changes are expected in the present airspace structure that will demand changes in applied RNAV values. The only exception will be RNP-10 application in the WATRS Region, which will demand a significant change in the CAR Region airspace structure. In airspaces where RNP-10 is applied (EUR/SAM Corridor, Lima-Santiago de Chile Routes and South Atlantic Random Routes System), no short-term changes are expected.

7.3.1.2 In the continental airspace, RNAV-5 implementation in selected airspaces is expected, where possible to obtain operational benefits and available CNS infrastructure is able to support it.

7.3.2 TMA operations (SIDs and STARs)

7.3.2.1 The application of RNAV-1 in State-selected TMAs, in radar environments, with ground navigation infrastructure is expected, which permits DME/DME and DME/DME/INS operations. In this phase mixed operations (equipped and non-equipped) will be admitted, and RNAV-1 operations shall be initiated when an adequate percentage of air operations are approved.

7.3.2.2 In non-radar environments and/or in environments that do not count with adequate ground navigation infrastructure, the application of RNP-1 is expected in State-selected TMAs with exclusive application of GNSS, whenever an adequate percentage of air operations are approved. In this TMA will also be admitted approved and non-approved aircrafts. The application of overlay procedures or exclusive RNP procedures will depend on air traffic complexity and density.

7.3.3 IFR approaches

7.3.3.1 The application of RNP 0,3 approach procedures (basic GNSS) is expected in the maximum possible of State-selected airports, principally in international airports, maintaining conventional approach procedures for non-equipped aircraft.

7.3.3.2 The application of RNP AR approach procedures is expected in State-selected airports, where obvious operational benefits can be obtained, based on the existence of significant obstacles.

Short Term (until 2010)	
Airspace	**RNAV or RNP Value**
Route (Oceanic o Remote)	RNP 10 Corridor EUR/SAM and Santiago/Lima/AORRA/WATRS
Route (Continental)	RNAV 5 in selected airspaces
TMA	RNAV-1 in radar environment and with adequate ground navigation infrastructure.
	RNP 1 – No radar environment and/or without appropriate DME coverage.
Approach	RNP 0,3 in most possible airports and in all international airports. RNP AR in airport where there are obvious operational benefits.
• Non compulsory installation of RNAV equipment on board of non equipped aircraft in TMA and APP • Mixed Operations (equipped and non equipped aircraft) in TMA and APP • Required RNAV 2 equipment above FL350 for flights to/from United States.	

7.4 **Medium term**

7.4.1 En-route operations

7.4.1.1 The application of RNP 4 in the oceanic airspace in EUR/SAM corridor is expected, with utilization of ADS/CPDLC, in order to permit the use of lateral and longitudinal separation of 30 NM. This application will depend on the evolution of the aircraft fleet flying in the airspace.

7.4.1.2 In this phase, the application of RNP-2 is expected in selected areas of the continental airspace, with high air traffic density and exclusive application of GNSS, depending on the analysis of ground infrastructure, which will indicate whether it is possible to use RNAV applications. The establishment of a backup system will be necessary as well as the development of contingency procedures in the event of GNSS failure. The application of RNP-2 will facilitate the PBN application is non surveillance airspace. With the exclusive application of GNSS more control of the GNSS signal is needed, through GPS Monitoring Systems that include NOTAM, FDE, etc.

7.4.2 TMA operations

7.4.2.1 In this phase, it is expected to extend the application of RNAV (RNP) 2/1 in State-selected TMAs, depending of ground infrastructure and of aircrafts navigation capacity. In TMAs of high air traffic complexity and movement (excluding airspaces), the use of RNAV or RNP 1 equipments will be mandatory. In TMAs of less air traffic complexity, mixed operations will be admitted (equipped or non-equipped).

7.4.3 IFR approaches

7.4.3.1 In this phase the extended application of procedures RNP 0.3 and RNP AR in selected airports is expected. Also, the initiation of application of GLS procedure is expected to guarantee a smooth transition between TMA phase and the approximation ´has, basically using GNSS for the two phases.

Medium Term (2011-2015)	
Airspace	**RNAV or RNP Value**
Route (Oceanic or Remote)	RNP 4 in EUR/SAM Corridor and Santiago/Lima
Route (Continental)	RNP 2 in selected airspaces
TMA (SID/STAR)	Expansion of RNAV-1 or RNP-1 application Compulsory RNAV 1 or RNP 1 approval for aircraft operating in greater air traffic density TMAs (exclusionary airspace)
Approach	Expansion of RNP 0,3 and RNP AR application Application of GLS procedures
• RNP2 required equipment over FL290 for flights to/from United States.	

8. SAFETY ASSESSMENT

8.1 The implementation of the performance based navigation forecast significant safety-related changes in the airspace structure as well as to the ATC system, including the implementation of reduced separation minima or new procedures that only shall be applied after a safety assessment has demonstrated that an acceptable level of safety will be met.

8.2 To demonstrate that the system is safe it will b necessary to execute a safety assessment of the proposed operation. This will take two forms:

1) A collision risk assessment for the proposed RNAV system specification;

2) A safety case for the operation.

8.3 After the PBN applications implementation, all the system should be monitored in order to ensure to maintain operational safety. In case of unforeseen events, dependency in charge of monitoring should propose and coordinate with all interested parts the implementation of mitigating measures as soon as possible.

A-1
APPENDIX X1

Reference documentation for developing operational and airworthiness approvals

Organisation	Code	Title
ICAO	Doc (under development by the RNPSORSG)	Performance-based navigation (PBN)
ICAO	Doc 8168 – OPS/611	Aircraft operations
ICAO	Doc 4444	Procedures for air navigation services – Air traffic management
ICAO	Doc 8733	CAR/SAM air navigation plan
ICAO	Doc 7030/4	SAM Regional supplementary procedures (SUPPS)
FAA	Order 8400.10	Required navigation performance 10 (RNP 10) operational approval
FAA	AC 90-96	Approval of US operators and aircraft to operate under instrument flight rules (IFR) in European airspace designated for basic area navigation (BRNAV/RNP 5)
FAA	AC 90-100	US Terminal and en route area navigation
FAA	AC 90-101	Approval guidance for RNP procedures with SAAAR
FAA	Order 8260.52	United States standards for required navigation performance (RNP) approach procedures with special aircraft and aircrew authorization required (SAAAR)
JAA	Leaflet No. 2 (TGL 2) Rev 1	Guidance material on airworthiness approval an operational criteria for the use of navigation systems in European airspace designated for basic RNAV operations
JAA	Leaflet No. 3 (TGL 3) Rev 1	Interim guidance material on airworthiness approval and operational criteria for the use of the NAVSTAR Global Positioning System (GPS)
JAA	Leaflet No. 10 (TGL 10)	Airworthiness an operational approval for precision RNAV operations in designated European airspace
EUROCONTROL	Doc 003-93	Area navigation equipment: operational requirements and functional requirements
RTCA	Do-236B	Minimum aviation system performance standards: Required navigation performance for area navigation
RTCA	Do-238A	Minimum operational performance standards for required navigation performance for area navigation

Documentation availability

The documentation described in paragraph 1 of this document may be obtained at the following websites:

a) Copies of EUROCONTROL documents may be requested from EUROCONTROL, Documentation Centre, GS4, Rue de la Fusee, 96, B-1130 Brussels, Belgium; (Fax: 32 2729 9109). Website: http://www.ecacnav,com.

b) Copies of EUROCAE documents may be purchased from EUROCAE, 17 rue Hamelin, 75783 Paris Cedex 16, France (Fax: 33 1 4505 7230). Web site: http://www.eurocae.org.

c) Copies of FAA documents may be obtained from the Superintendent of Documents, Government Printing Office, Washington, DC 20402-9325, USA. Website: http://www.faa.gov/certification/aircraft/ (Regulation and guidance library).

d) Copies of RTCA documents may be obtained from RTCA Inc., 1140 Connecticut Avenue, N.W., Suite 1020, Washington, DC 20036-4001, USA, (Tel: 1 202 833 9339). Website: www.rtca.org.

e) Copies of ARINC documents may be obtained from Aeronautical Radio Inc., 2551 Riva Road, Annapolis, Maryland 24101-7465, U.S.A. Website: http://www.arinc.com.

f) Copies of JAA documents are available from the JAA´s Publisher Information Handling Services (IHS). Information on prices, where and how to order is available in the JAA website: http://www.jaa.nl and in the IHS websites: http://www.global.his.com and http://www.avdataworks.com.

g) Copies of EASA documents may be obtained from EASA (European Aviation Safety Agency), 101253, D-50452 Koln, Germany.

h) Copies of ICAO documents may be purchased from the Document Sales Unit, International Civil Aviation Organization, 999 University Street, Montreal, Québec, Canada H3C 5H7, Fax: 1 514 954 6769, or at: sales_unit@icao.org, or through national agencies.

APPENDIX C

INTERNATIONAL CIVIL AVIATION ORGANIZATION

Caribbean/South American Air Traffic Flow Management Concept of Operation

(CAR/SAM CONOPS ATFM)

Version	Draft 0.1
Date	October 2006

FOREWORD

The *Caribbean/South American ATFM Concept of Operations (CAR/SAM CONOPS ATFM)* is published by the ATM/CNS Subgroup of the Caribbean/South American Regional Planning and Implementation Group (GREPECAS). It describes air traffic flow management concept operational to be applied in both regions.

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

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

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MEXICO CITY, MEXICO

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The present edition (Draft Version 0.1) includes all revisions and modifications until October 2006. Subsequent amendments and corrigenda will be indicated in the Record of Amendment and Corrigenda Table, according to the procedure established in page 3.

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

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS			
No.	Date applicable	Date entered	Entered by

CORRIGENDA			
No.	Date applicable	Date entered	Entered by

AMENDMENTS TO THE DOCUMENT

1. The Caribbean and South American (CAR/SAM) ATFM Concept of Operations is a regional document that includes aeronautical scientific and technological advances; as well as the operational experiences, both of the CAR/SAM Regions as of the other ICAO Regions that may affect ATFM concepts and procedures therein established in the same.

2. Due to this particularity, the ATFM CONOPS is also a dynamic document, in permanent progress and permeable in order to accept every modification originated by the constant improvement in the aeronautical disciplines and activities that enable its harmonious use in the CAR/SAM Regions, ensuring air operations safety.

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

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

5. The framework of the sections and parts, as well as the page numbering have been developed so as to provide flexibility, facilitating the review or the addition of new texts. Each Section is independent and includes an introduction giving its purpose and status.

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

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

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

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

Page

Document content

GLOSARIO DE ACRÓNIMOS/ACRONYMS GLOSSARY

ACC	Centro de control de área Area control center Aeronautical fixed service
AFTN	Red de telecomunicaciones fijas aeronáuticas Aeronautical fixed telecommunication network
AIP	Publicación de Información aeronáutica Aeronautical Information Publication
AIS	Servicio de información aeronáutica Aeronautical information service
ANP	Plan navegación aérea Air navigation plan
ANS	Servicios de navegación aérea Air navigation services
ANSP	Proveedor de servicios de navegación aérea Air navigation service provider
AO	Operador de aeronave Aircraft operator
APP	Oficina de control de aproximación Approach control office
ATC	Control de tránsito aéreo Air traffic control
ATFM	Gestión de la afluencia del tránsito aéreo Air traffic flow management
ATM	Gestión del tránsito aéreo Air traffic management
ATS	Servicios de tránsito aéreo Air traffic services
CAA	Administración de aviación civil Civil aviation authority
CAR/SAM	Regiones Caribe y Sudamérica Caribbean and South American Regions
CATFM	Dependencia de Gestión de la afluencia del tránsito centralizada Centralized air traffic flow management unit
CBA	Análisis de costo/beneficios Cost/benefit analysis
CNS/ATM	Comunicaciones, navegación y vigilancia/gestión del tránsito aéreo Communications, navigation, and surveillance/air traffic management
FDPS	Sistema de procesamiento de datos de vuelo Flight data processing system
FIR	Región de información de vuelo Flight information region
FMU	Dependencia de organización de la afluencia Flow management unit
FMP	Puestos de gestión de afluencia Flow management position

FPL	Plan de vuelo Flight plan
GREPECAS	Grupo regional de planificación y ejecución CAR/SAM CAR/SAM regional planning and implementation group
MET	Servicios meteorológicos para la navegación aérea Meteorological services for air navigation
OACI/ICAO	Organización de aviación civil internacional International civil aviation organization
PANS ATM	Procedimientos para los servicios de navegación aérea –Gestión de tránsito aéreo Procedures for Air Navigation Services –Air traffic management
PIRG	Grupo regional de planificación y ejecución Planning and implementation regional group
TBD	A ser determinado To be determined
TMA	Area de control terminal Terminal management area
TWR	Torre de control Tower
WWW	Red mundial World Wide Web

Explanation of terms and expressions

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

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

Routing area. A routing area encompasses one or more major traffic flows, defined for the purpose of developing a detailed plan for the implementation of ATM systems and procedures.

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

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

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

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

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

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

Air Traffic Management.- Service which comprises airspace management, air traffic flow management and air traffic services.

Flight Management Position/Unit – FMP/FMU).- A position or working unit established in an appropriate air traffic control unit to ensure the necessary interphase between the local ATFM and a centralized ATFM units related to air traffic flow management – ATFM.

Main Traffic Flows.- It is a concentration of significant volumes of air traffic on the same or proximate flight trajectories.

Air Traffic Management System.- A system which provides ATM through the integration in cooperation with human beings, information, technology, facilities and services, with the support of communications, navigation and surveillance on board and spatial based.

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

Executive summary

GREPECAS considered that early ATFM implementation shall ensure optimum air traffic flow towards specific areas or through them during periods in which the demand exceeds or is foreseen to exceed available capacity of the ATC system. Therefore, an ATFM system should reduce aircraft delays both in flight and ground and avoid system overloading.

In this connection, GREPECAS approved the operational concept described herein, which reflects the expected order of events which might occur and should assist and guide the planners in the design and gradual development of ATFM system, in order to provide safety and effectiveness, and ensure an optimum air traffic flow towards certain areas or through them during periods in which the demand exceeds or is foreseen to exceed the available capacity of the ATC system.

The main actors involved in air traffic flow management have been identified taking considering as ATFM community the organizations, bodies or entities which might participate, collaborate and cooperate in the planning, development, use, regulation, operation and maintenance of the ATFM System.

From the analysis of the statistics it may be noted that during the period 1994-2004, the passengers regular traffic (in PKP) of airlines in the Latin American and Caribbean Region grew at an average annual rate of 3.3% (in comparison to the 5.1% annual rate of global growth, foreseeing that air traffic growth continues to gradually improve at mid term, at the same time that the economical activity.

The total of operations of the main airports of the CAR Region in the period 2002 to 2005 reflected a positive trend of 1.92%. However, in the same period the trend in the SAM Region was negative –0.56% being the global trend positive 0.66% for both regions.

Also, several airspaces with common interests have been identified as regards air traffic management, based on similar characteristics of traffic density, complexity and air navigation system infrastructure requirements within which a common plan shall foster the implementation of an ATM Global Concept. A description of such homogeneous and routing areas is attached as CAR/SAM ATFM CONOPS.

As established in ICAO documents, air traffic flow management should be implemented within a region or within other defined areas as a centralised ATFM organization, with the support of flow management units (FMU) established in each ACC within the region or area of application.

In view of the above, this document describes the main objective of the centralised ATFMs which has as main task to contribute so that the ATC may use to the maximum possible extent its capacity and, as required, issue flow management initiatives to maintain a safe, orderly and expeditious air traffic circulation, ensuring that air traffic volume is compatible with declared capacities making at the same time a description of principles and functions and establishing some requirements as regards units equipping or air traffic flow management units and the proper centralised ATFM units.

In the current operational concept, GREPECAS establishes a simple implementation strategy through the development in phases in order to ensure maximum utilisation of available capacity and permit all parties concerned to obtain sufficient experience. The implementation would be initiated with the application of basic ATFM procedures in airports and in an evolutionary manner to reach more complex phases, without the immediate need for a regional ATFM centre, since its implementation would demand further studies to define operational concepts, systems requirements and institutional aspects for its implementation.

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

1. History

1.1 ICAO CNS/ATM Systems received support from the Tenth Air Navigation Conference held in 1991 at ICAO Headquarters in Montreal, Canada. The same year, the CAR/SAM Regional Planning and Implementation Group (GREPECAS) started to work towards a regional application of this new air navigation services concept.

1.2 Further, at the Eleventh Air Navigation Conference (AN-Conf/11, Montreal September 2003), States supported and approved the new ICAO ATM Global Operational Concept, which encourages the implementation of a services management system which enables an operationally continuous regional airspace through the application of a series of ATM functions.

1.3 As per the guidance principles established by ICAO Council with regard to the facilitation of the inter-regional harmonization, the regional plans for CNS/ATM systems implementation in the regions should be prepared in accordance to the general profiles defined in the Global Air Navigation Plan for CNS/ATM Systems. After a careful analysis of the guidance principles of this Global Plan, GREPECAS adopted them and incorporated characteristics inherent to the CAR/SAM Regions, using as a basis the definitions of Homogeneous Areas and Main Traffic Flows. Homogeneous areas are those airspace portions with ATM requirements and similar complexity degrees, while main air traffic flows are airspaces where a significant amount of air traffic exists.

1.4 From the analysis carried out by ICAO/UNDP Project RLA/98/003, it may be inferred that while in general terms in the CAR/SAM Regions environment, currently no traffic congestions are registered requiring a complex flow management, they have been identified in some airports and airspace sectors, mainly in special periods and specific hours, where some congestions are already produced, which should be avoided.

1.5 In view of the above, GREPECAS considered that the early implementation of the ATFM shall ensure an optimum air traffic flow towards some areas or through them, during periods in which the demand exceeds or is foreseen to exceed the available capacity of the ATC system. Therefore, an ATFM system should reduce aircraft delays both in flight and ground and avoid system overloading. The ATFM system shall assist the ATC to comply with its objectives and achieve a more effective utilisation of the airspace and airports available capacity. ATFM should also ensure that air operations safety is not compromised in case unacceptable levels of air traffic congestion occur and at the same time ensure that air traffic is effectively administered without applying unnecessary restrictions to flow.

2. Purpose of the document

2.1 This document on CAR/SAM Air Traffic Flow Management Operations Concept (ATFM) is oriented towards the description of a high level on the service to be provided in the CAR/SAM Regions in a specific time horizon. It explains the current situation and which shall be the future situation to be progressively reached through a series of specific change stages.

2.2 The operational concept described herein reflects the expected order of events which might occur and should assist and guide the planners in the design and gradual development of ATFM system, in order to provide safety and effectiveness, and ensure an optimum air traffic flow towards certain areas or through them during periods in which the demand exceeds or is foreseen to exceed the available capacity of the ATC system.

3. Actors involved in ATFM

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

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

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

3.4 ***Airspace users***.- mainly referring to airlines and pilots.

3.5 ***ATM service providers.-*** are constituted by all organizations and personnel (i.e. controllers, engineers, technicians) implied in the provision of ATFM services to airspace users.

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

3.7 ***International Civil Aviation Organization (ICAO)***.- considered as the only international organization in conditions to efficiently coordinate implementation activities of global ATM leading to become real a continuous global ATM.

4. Trends and traffic forecasts in the main airports of the CAR/SAM Regions

4.1 During the period 1994-2004, the Latin American and Caribbean Region's airlines passengers' regular traffic (in PKP) grew at an annual average of 3.3% (in comparison to the global annual average growth rate of 5.1%). Until year 2000 privatisation of national carriers fusions and inter-regional alliances, together with a wide rationalization of fleets and routes, counted among the measures that enabled airlines of the regions to capture a greater portion of traffic of United States – Latin America and Caribbean, one of the aviation markets with greater growth rate. After high traffic growth rates in 1997 and 1998 (9.5% and 7.8% respectively), the passengers traffic decreased in 1999 in a 0.3% but it was recovered in 2000 with a growth rate of 4.4%, decreasing again in 2001 in 5.1%. The traffic decreased in 1.6% in 2002 before recovering in 2003 (3.8%) and 2004 (8.4%). In some CAR/SAM areas the traffic growth in 2005 registered scopes of up to 13%.

4.2 Aircraft movement in the main airports in the period 2002-2005 would indicate that, in the CAR Region the total operations reflect a positive trend of 1.92% observing that in some States particularly, positive trends are reflected that vary from 2.42% to 6.41%. In the SAM Region, the total of operations reflected a negative trend of -0.56% between years 2002 to 2005 observing that some States particularly reflect positive trends which vary from 0.85% to 4.79%.

4.3 Making a balance of the previous information, it is observed that during years 2002 to 2005 the global trend in the CAR/SAM Regions is reflected in a positive 0.66%. It is foreseen that the traffic growth continues to gradually improve at mid term at the same time than economical activity.

4.4 For a better illustration, the evaluation of the information submitted by CAR/SAM States is shown in **Appendix A.**

5. Main traffic flows

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

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

6. Identification of areas and/or routes where traffic congestion is produced

6.1 Currently, saturation periods have been identified in several airports and traffic flows of some of the CAR/SAM Regions FIRs. In view of this, it is necessary that CAR/SAM States maintain identified the saturation periods of their respective airports, terminal areas and traffic flows.

7. Objectives, principles and functions of a Centralized ATFM

Objective of the Centralized ATFM

7.1 As established in the PANS ATM (Doc 4444) air traffic flow management should be implemented within a region or within other defined area, as a centralized ATFM organization with the support of flow management positions (FMP) established in each ACC within the region or area of application.

7.2 The objective of the Centralized ATFMs shall be to contribute so that the ATC use to the maximum possible extent its capacity and, as required, shall issue flow management initiatives to maintain a safe, orderly and expeditious air traffic circulation, assuring that the traffic volume is compatible with the declared capacities.

7.3 Consequently, and aware of their operational needs in agreement with its reality as regards ATC service, air traffic and airport problems, as well as air traffic volume, administrations should define whether a FMU is necessary, which in addition to communicating with the Centralized ATFM, may manage and coordinate the implemented Flow Management Position (FMP) implemented in ATC units which so require or adopt the direct communication process from these FMPs with the Centralized ATFM.

Principles in which ATFM will be based

7.4 Regional ATFM structure should be composed in such a manner that each State/Territory and International Organization of the CAR/SAM Regions may have access to a Centralised ATFM corresponding through an organization adequate to their needs and developed as per guidelines determined on this matter.

7.5 The Centralized ATFM, to comply with its objectives, should be based on the following principles:

a) To be at disposal of all States/Territories and International Organizations in the region under their responsibility, considering the requirements of operators, airports, ATC units and other pertinent ATFM units.

b) Use a common and permanently updated database.

c) Take pertinent measures well in advance to prevent and/or minimise overloads.

d) Keep close and continuous coordination with flow management units (FMUs) and/or flow management positions (FMPs), aircraft and airport operators, corresponding ATC units and other pertinent Centralized ATFM units.

e) Take measures that ensure that existing delays are equitably distributed among operators.

f) Apply quality management to the services provided.

g) Base the implementation of ATFM measures in the collaborative decision making (CMD) process.

h) Favour, to the maximum possible, the use of the existing capacity without compromising safety.

i) Contribute in the achievement of the global ATM objectives.

j) Have the necessary flexibility to enable operators to change their arrival or departure schedules.

Functions of a Centralized ATFM

7.6 To provide Air Traffic Flow Management (ATFM) service, the Centralized ATFM should comply with the following activities:

a) Establish and maintain a data base in the region under its responsibility on:

- the air navigation infrastructure, ATS units and registered aerodromes;
- pertinent ATC and airport capacity; and
- flight data foreseen.

b) Establish a coherent chart of foreseen air traffic demand, a comparison with available capacity and determination of areas, and a time-frame of critical air traffic overloads foreseen;

c) Make the necessary coordination to make every possible attempt to increase the capacity available, when necessary.

d) When deficiencies in the capacity available matter may not be eliminated, determine and timely apply ATFM measures, as required, previously coordinated with aircraft operators and interested aerodromes.

e) Carry out a follow-up on the result of measures adopted.

f) Coordinate ATFM service with the other centralized ATFM units, when so required.

8. Equipment requirements for FMU/FMP and Centralized ATFM

8.1 The implementation of the ATFM shall require identifying and determining which would be the minimum requirements for the implementation of the service and the Centralized ATFM, FMU, or FMP in each CAR/SAM Regions ATC unit.

*Note: A more detailed description of these requirements is shown in **Appendix C** to this document.*

9. Personnel requirements for FMU/FMP and Centralized ATFM

9.1 Personnel performing in the Centralized ATFM as well as FMU/FMP functions shall require training and shall be qualified to provide an efficient flow management service. A detailed planning of ATFM training in advance shall ensure the optimisation of benefits in terms of capacity and operational efficiency and that personnel from FMU/FMPs be able to satisfactorily face the important change in their operational environments, ensuring high levels of continuous security.

10. Operational procedures

10.1 The operational procedures of the Centralized ATFM as well as those for the FMUs and FMPs should be developed in separate documents. These documents should describe the procedures applicable between the ATFM and all the FMUs/FMPs. Changes in these procedures shall be first agreed upon and shall be published as amendments to operational procedures prior to consultation to all parties involved.

10.2 The purpose of these documents shall be to assist personnel from the Centralized ATFM and FMUs/FMPs to establish a common understanding of the roles of each party interested in the effective provision of the flow management service and the capacity to air traffic services control and to aircraft operators.

10.3 ATFM measures should be addressed to traffic flows or flight series and to specific flights and days. To this end, planning, strategies development, and day-to-day monitoring, should be made. With regard to the above, ATFM activities could be developed in three phases: strategic - up to 48 hours before the day of the operation; pre-tactical - during 48 hours prior to the operation day; and, tactical - during the day of the operation. During all ATFM phases, responsible units should maintain a close liaison with ATC and with aircraft operators to ensure an effective and equitable service.

11. ATFM Implementation Strategy

11.1 The operational concept establishes a simple implementation strategy. This strategy should be develop in phases, so as to ensure maximum utilisation of the available capacity and enable all concerned parties to obtain sufficient experience.

11.2 The experience acquired in other Regions and by some States in the CAR/SAM Regions permits States/Territories and International Organizations to apply basic ATFM procedures in airports, without the immediate need for a Regional ATFM Centre. A Regional ATFM Centre shall demand ample studies to define operational concepts, requirements of systems and institutional aspects for ATFM implementation in the CAR/SAM Regions.

12. ATFM implementation stages

12.1 In order to enable maximum use of all resources available in the regions, either from personnel, equipment, facilities and/or automated systems, the implementation process of ATFM should be established, planned and developed in stages, according to the following sequence:

ATFM Airport Strategic

12.2 Normally the adoption of strategic flow management measures in airports located in airspaces of air traffic low density, avoids congestion and saturation of such airspace. Another aspect to be considered is that the adoption of ATFM strategic measures in airports are more simple to apply, keeping in mind that they demand a reduced data collection of flight intentions (RPL, Official Airline Guide - OAG, flight lists etc) and the use of automation and existing infrastructure tools.

12.3 The implementation process of ATFM in the CAR/SAM Regions should start with the establishment of a common methodology of estimation of the airport capacity which would enable identification of airports where periods exist in which demand is higher than capacity. As of that identification, measures could be adopted with a view to optimise the utilisation of the existing capacity.

12.4 ATFM strategic measures in airports should be limited to the use of Airport Slots and would have as objective to ensure a balance between the demand of regular flights and airport capacity. The application of slots would ensure the hour distribution of flights in airports.

12.5 Therefore, airports slots distribution procedures should be developed to operators which perform regular flights in function to the saturation/congestion of airports. The necessary capacity for other airspace users (non-regular flights) should also be kept in mind.

ATFM Airport tactical

12.6 The evolution of ATFM measures in airports should evolve towards the inclusion of non-regular flights in balancing procedures between demand and capacity. The adoption of ATFM tactical measures in airports would be still of low complexity. However, it would demand an increase in the data collection programme for intention flights in order to include FPLs and it would be necessary in addition to the use of tools of automation and existing infrastructure tools, the use of an efficient communications means between aircraft operators which perform non-regular flights and FMUs or FMPs.

12.7 ATFM tactical measures in airports would continue to be limited to the use of airport slots. However, the balance between demand and airport capacity would also consider non-regular flights. At this phase, slots distribution procedures to operators should also consider non-regular flights.

12.8 It is expected that strategic measures in airports be sufficient to solve specific problems in airports where there is a significant demand of regular flights, while tactical measures would be applied only to airports in which a significant amount of non-regular flights are carried out.

ATFM Airspace strategic

12.9 From the experience acquired in the demand and airport capacity management, States/Territories and International Organizations should consider airspace analysis, mainly those in

which ATFM measures in airports are not sufficient to solve congestion and airspace saturation problems. These ATFM strategic measures should avoid congestion and airspace saturation. The adoption of these measures would be of low complexity since it would only include their influence in the establishment of airports slots. However, it would demand the use of more sophisticated automation and infrastructure tools which permit the analysis of air traffic movement in each airspace portion, in order to identify congestion or saturation in control sectors.

12.10 The balance between demand and capacity would consider regular flights that are carried out. At this phase airports slots distribution procedures should take into account airports and airspaces saturation/congestion previsions.

12.11 It is expected that strategic ATFM measures in the airspace are sufficient to prevent overload of control sectors, mainly in those airspaces in which there is a significant over-flights demand.

ATFM Airspace tactical

12.12 At this ATFM implementation phase, States/Territories and International Organizations should move to the most complex phase which involves ATFM tactical measures related to airspace, including dynamic procedures that are applied to flights carried out in few hours. The adoption of airspace tactical measures would be very complex since it would include the application of ATC slots, as per a continuous analysis of the relationship demand/capacity. This analysis would demand the use of more sophisticated automation and infrastructure tools than in the previous phase, which permit the assignment of ATC slots, addressed to avoid overloads of airspace sectors and airports.

12.13 It is expected that airspace tactical ATFM be implemented only in States/Territories and International Organizations where there is a clear operational requirement, keeping in mind that the complexity of the application of tactical measures in airspace shall have a high cost in automated systems, data bases, telecommunications system and human resources training.

12.14 States/Territories and International Organizations who decide to implement airspace tactical ATFM should develop standards, procedures and operational manuals applicable to ATFM service.

13. Centralized ATFM implementation strategy in the CAR/SAM Regions

13.1 GREPECAS/13 was of the opinion that two CAR and SAM scenarios should be taken into account, but that they could be modified insofar as the operational concept development and the implementation plans progress. The strategy is to develop a harmonized planning of a CAR and SAM interregional ATFM system.

13.2 In order to maximise its efficiency, it was considered that Centralized ATFM should have the responsibility of providing service on the maximum extension of airspace possible, provided that this is homogeneous. In accordance with ATFM planning in the CAR and SAM Regions, it will have at least two Centralized ATFMs, one for each region.

13.3 It was also considered necessary that the procedures during all the implementation process be developed in a harmonious manner among the ATFM units to avoid risking operational safety. This entails establishing a regional and interregional strategy to facilitate and harmonize all the implementation process. The ATFM Task Force will accomplish these planning and harmonization objectives while for the implementation, two scenarios will be established depending on the operational needs and own features of each CAR and SAM Region. The activation of two ATFM Implementation Groups was considered, one for each Region.

13.4 It was considered that operational implementation should be carried out in phases, according to ICAO Doc 9854 – *Global air traffic management operational concept*, in order to permit a progressive implementation and acquire necessary capacities for an adequate implementation. Each phase should be implemented, based on operational configurations, descriptive documents of the operational models and systems, as per the established strategy.

13.5 In order to harmonize the National Plans with the Regional CAR/SAM ATFM Regional Plan, it is necessary that the civil aviation administrations take the required measures and make a closer follow-up of the regional development of the ATFM and prepare a ATFM implementation programme where implementation needs are determined, the impact that will have in the national ATC system, air traffic services as well as in operations and airport services be analysed, and pertinent coordinations are established, which make it possible an integral regional, timely and harmonious implementation.

14. Special flights exempt from application of ATFM measures

14.1 Aircraft complying ambulance flights, humanitarian flights, search and rescue operations to State aircraft in international flights would be exempt from the application of ATFM measures. States would continue having under their criteria measures to be adopted on this matter regarding domestic flights.

15. Contingency plan

15.1 In case of a partial or total interruption of the flow management service and/or support services, ATFM and FMUs/FMPs will have the corresponding contingency plans prepared as per GREPECAS guidelines, in order to help to ensure the safe and orderly movement of air traffic. These plans should be incorporated to the documents related with operational procedures of the Centralized ATFM and FMUs/FMPs.

APPENDIX A

Evaluation of operations in the main airports of the Regions

1. The methodology used to verify the percentage trend of operations of an airport, a State, a Region, or both CAR/SAM Regions, was as follows:

a) The information was initially collected and processed in Excel.

b) A comparative procedure of one year with respect to the other was applied and it was divided between the year required for comparison either in percentage or numerical (operations).

c) A formula was applied to obtain global average of data collected in all years counted either by airport, State or Region.

d) Finally, to obtain the global data a sum was made of data processed in all years counted.

e) The data processed were designed in bar and linear graphics and numerical so that operational data appears in bars and lines by States. Even though this graphic may also be designed by airports.

2. Trends per regions as per aircraft movement in the period comprised between 2002 and 2005 were as follows:

a) CAR Region
The total of operations reflected a positive trend of 1.92% between years 2002 to 2005.

b) SAM Region
The total of operations reflected a negative trend of -0.56% between years 2002 to 2005.

c) CAR/SAM Regions
The global trend in both CAR/SAM Regions reflects in a positive manner 0.66% between years 2002 to 2005.

d) In the CAR Region, the following States reflect positive trends:

Cuba	6.41%
Dominican Republic	5.74%
Belice	4.77%
El Salvador	3.06%
México	2.57%
U. S. (P. R) (V. I)	2.51%
Guatemala	2.51%
Costa Rica	2.42%

e) In the SAM Region the following States reflect positive trends:

Venezuela	4.79%
Panamá	3.73%
Chile	2.59%
Bolivia	2.49%
Perú	0.85%

3. Analysis of data

Based on the information sent by States, an analysis on flights concentration in the CAR/SAM Regions was made. The result of such analysis is contained is as follows:

a) Approximately 80% of flights reported is concentrated in the following 7 countries, as shown below:

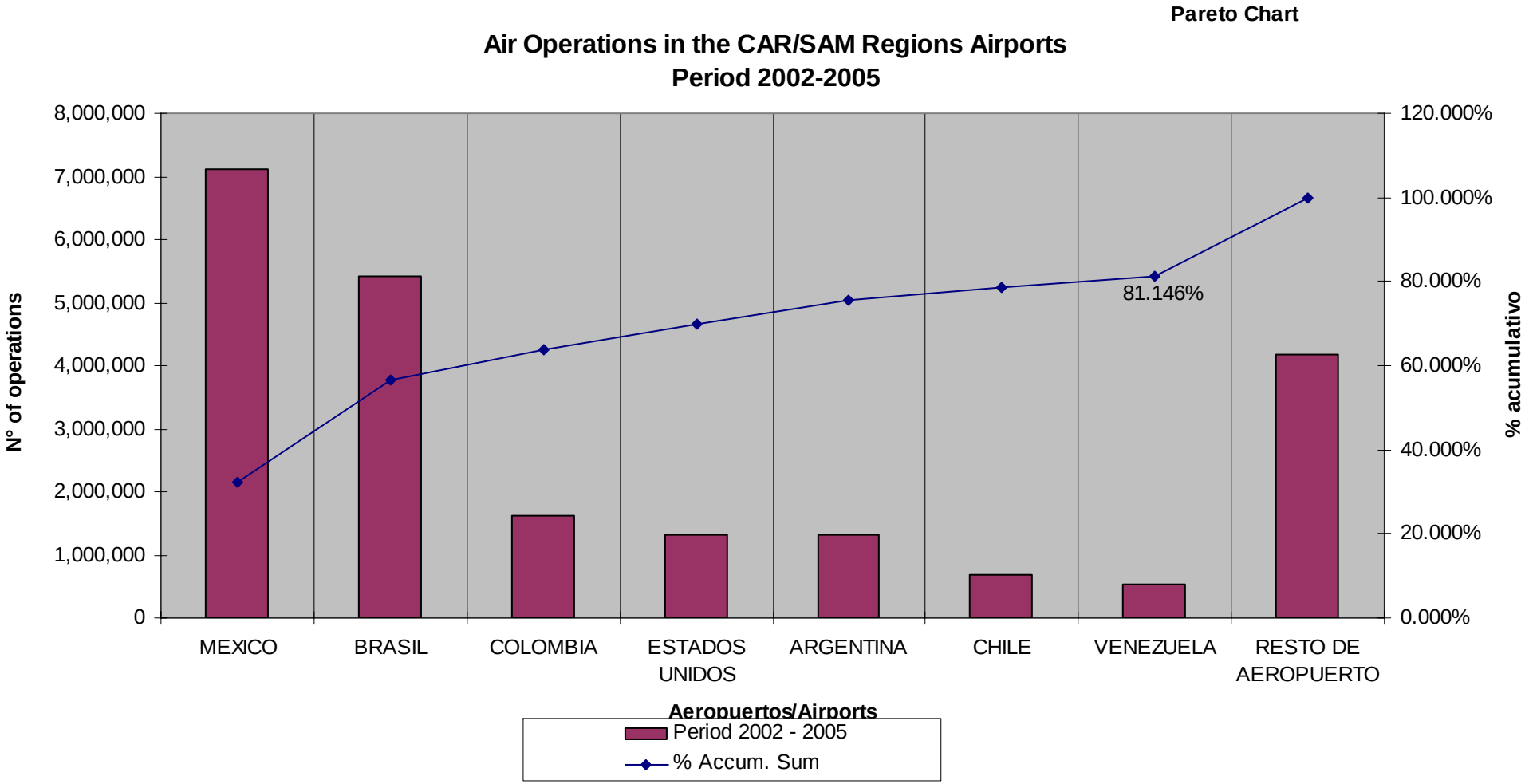
N°	AEROPUERTOS DE LAS REGIONES CAR/ SAM AIRPORTS IN THE CAR/SAM REGIONS	Periodo / Period 2002 - 2005	%
1	MEXICO	7,116,319.00	32.090%
2	BRASIL	5,412,758.00	24.408%
3	COLOMBIA	1,630,559.00	7.353%
4	ESTADOS UNIDOS/USA	1,328,879.00	5.992%
5	ARGENTINA	1,307,842.00	5.898%
6	CHILE	676,718.00	3.052%
7	VENEZUELA	522,090.00	2.354%
8	RESTO DE AEROPUERTOS/REST OF AIRPORTS	4,181,009.00	18.854%
	TOTAL	**22,176,174.00**	**100.000%**

b) From these seven (7) countries, 2 belong to the CAR Region: México with the greatest percentage in the CAR/SAM Regions (32.09%) and United States which occupies fourth place 5.99%). The rest of the places belong to SAM Region States. The flight volume generated in Brazil should be highlighted, representing a 24.408%, corresponding to the second place in both Regions.

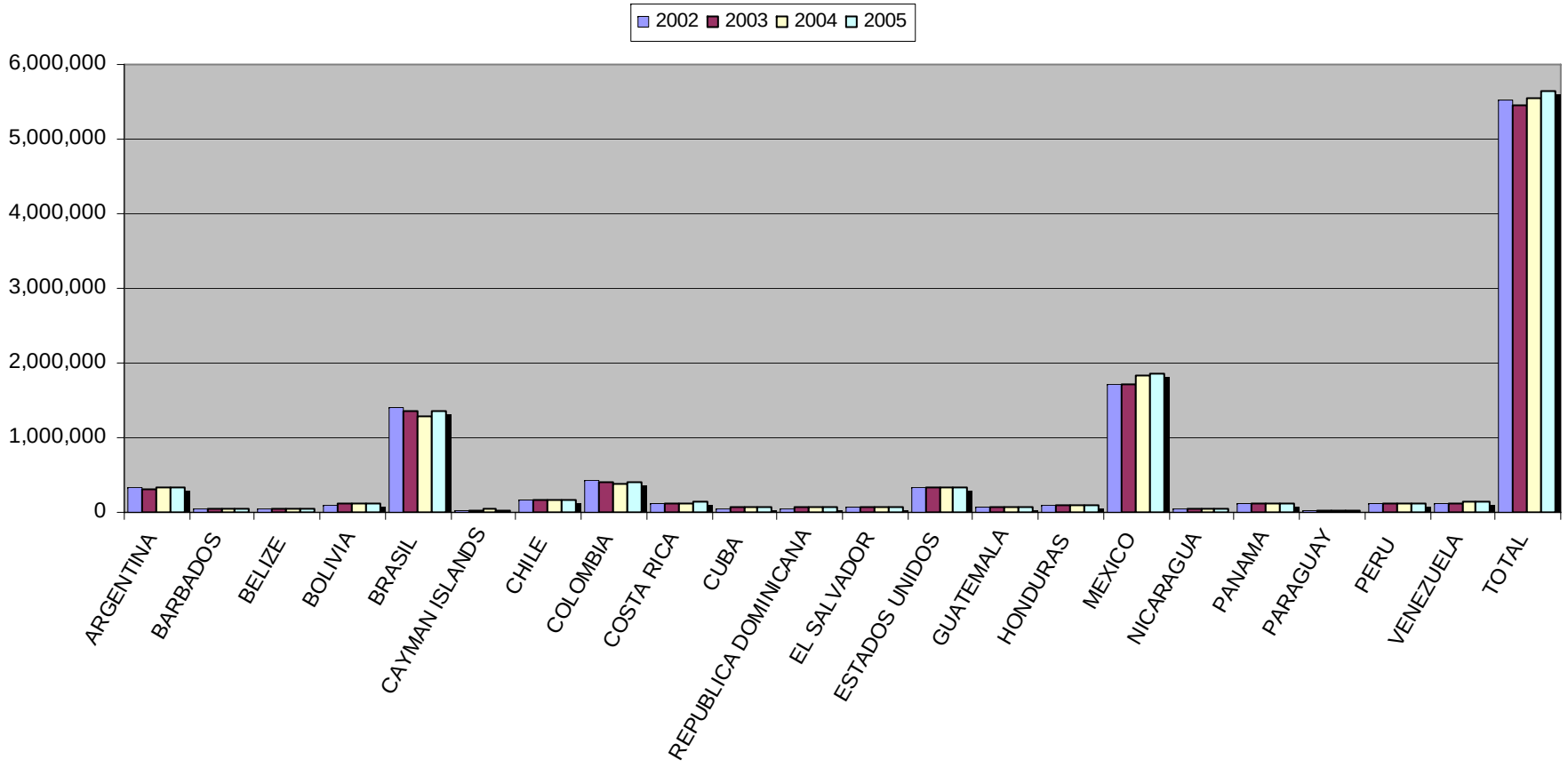
c) The rest of the States has been grouped in REST OF AIRPORTS, which individually contributes with non-significant margins (values of less than 5%) which jointly represent 18.854%.

d) It is considered that percentages reflected in the table of numeral i) shall not vary, taking into consideration that States which did not submit information (50%) are mostly Caribbean States from which it is deemed that their flight volumes are below **5%**, which would not affect the table shown above.

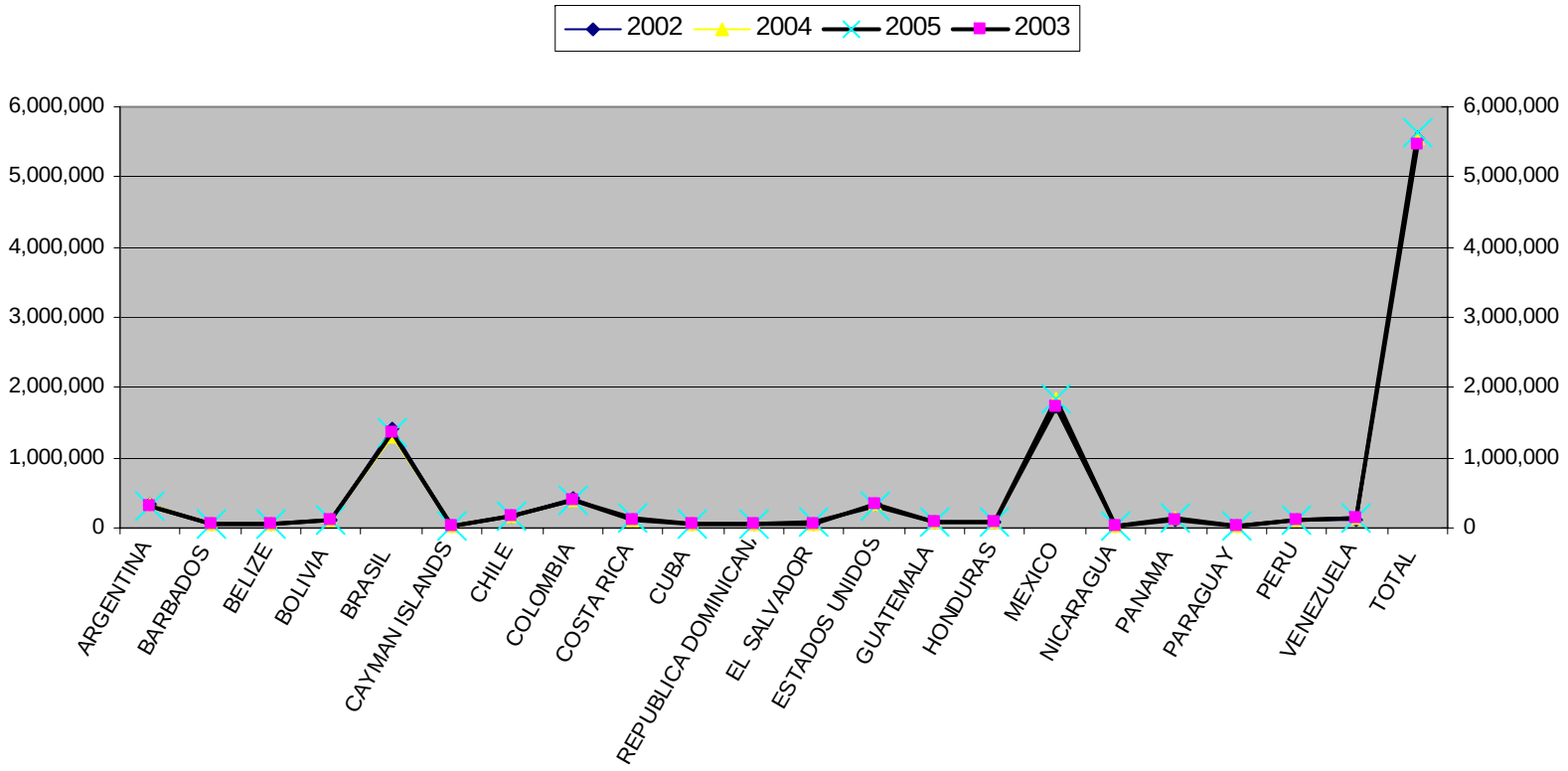
4. Resulting graphics


Pareto Chart
Air Operations in the CAR/SAM Regions Airports
Period 2002-2005
N° of operations
% acumulativo
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
120.000%
100.000%
80.000%
60.000%
40.000%
20.000%
0.000%
81.146%
MEXICO
BRASIL
COLOMBIA
ESTADOS UNIDOS
ARGENTINA
CHILE
VENEZUELA
RESTO DE AEROPUERTO
Aeropuertos/Airports
Period 2002 - 2005
% Accum. Sum

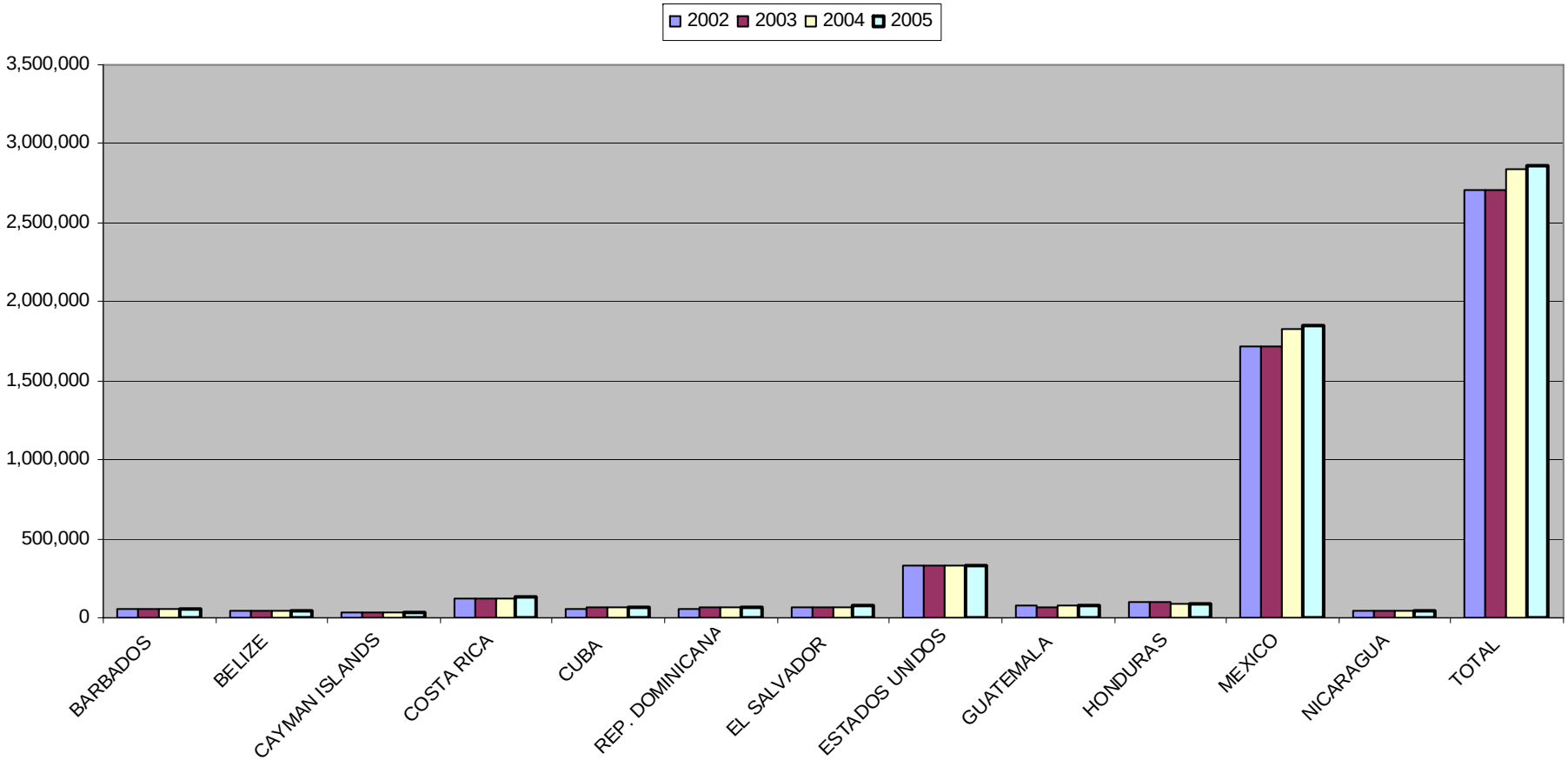
AIRCRAFT MOVEMENT IN CAR/SAM REGIONS AIRPORTS
PERIOD 2002 - 2005



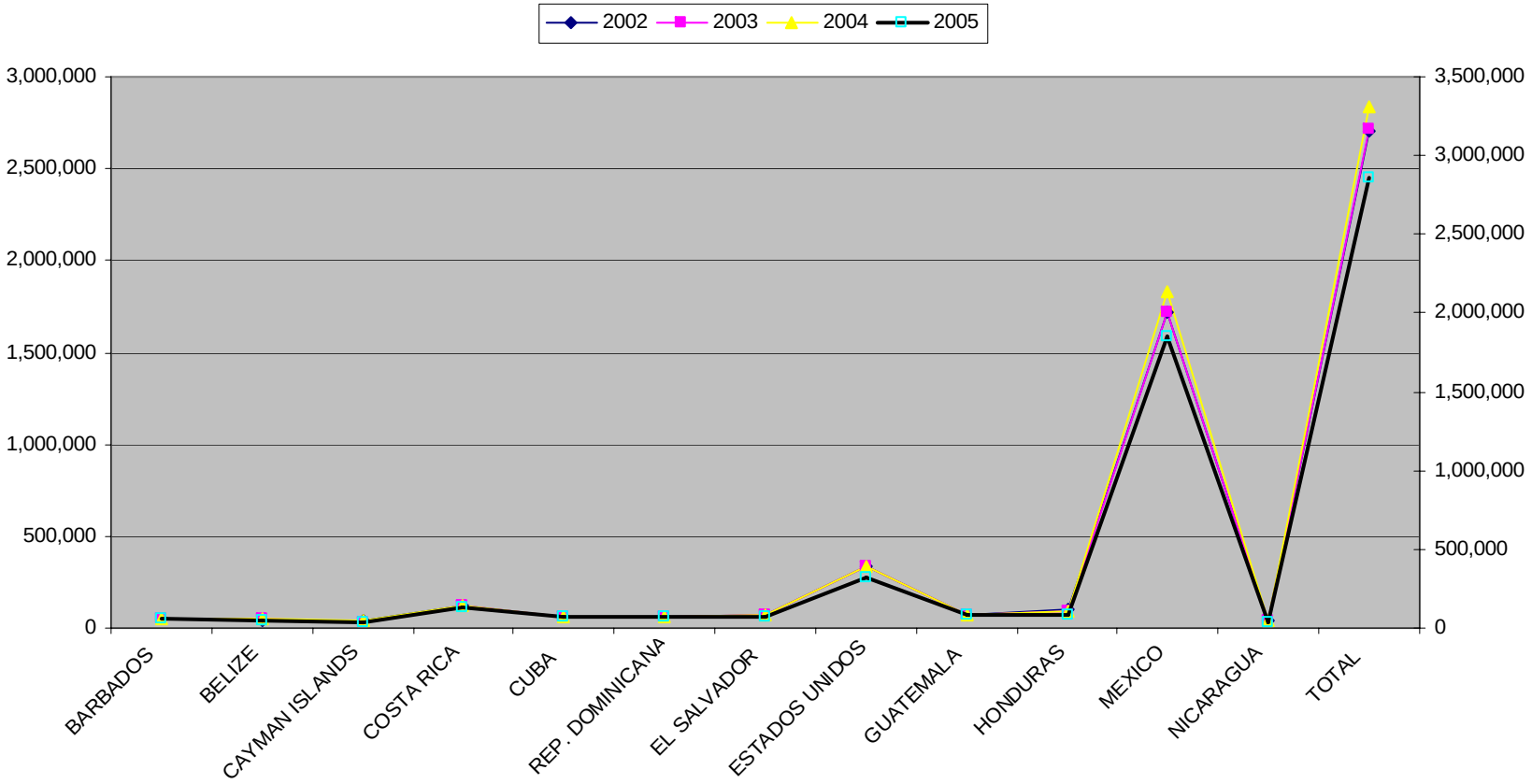
AIRCRAFT MOVEMENTS IN THE CAR/SAM REGIONS AIRPORTS
PERIOD 2002 - 2005



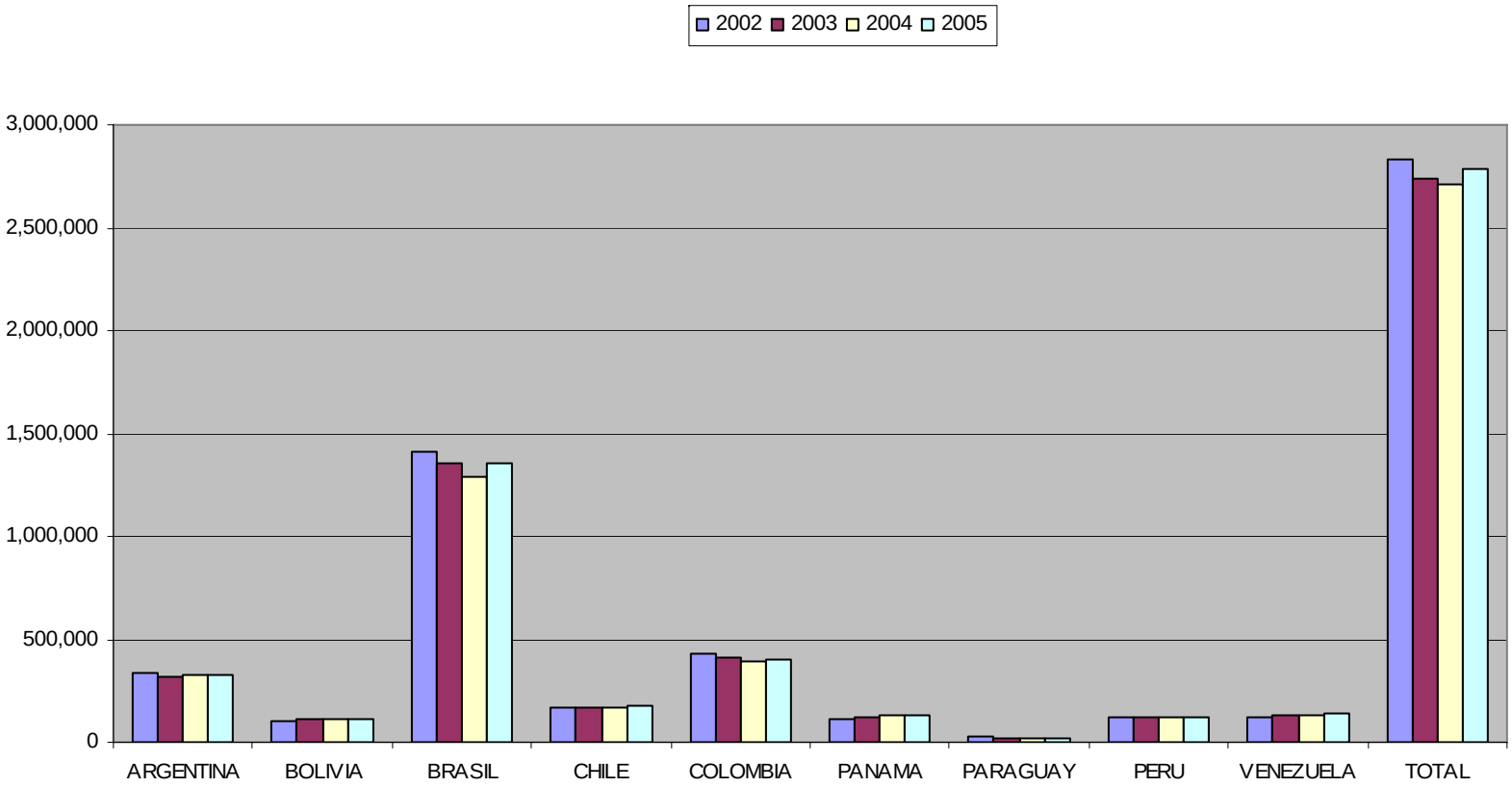
AIRCRAFT MOVEMENT IN THE CAR REGION AIRPORTS
PERIOD 2002 - 2005



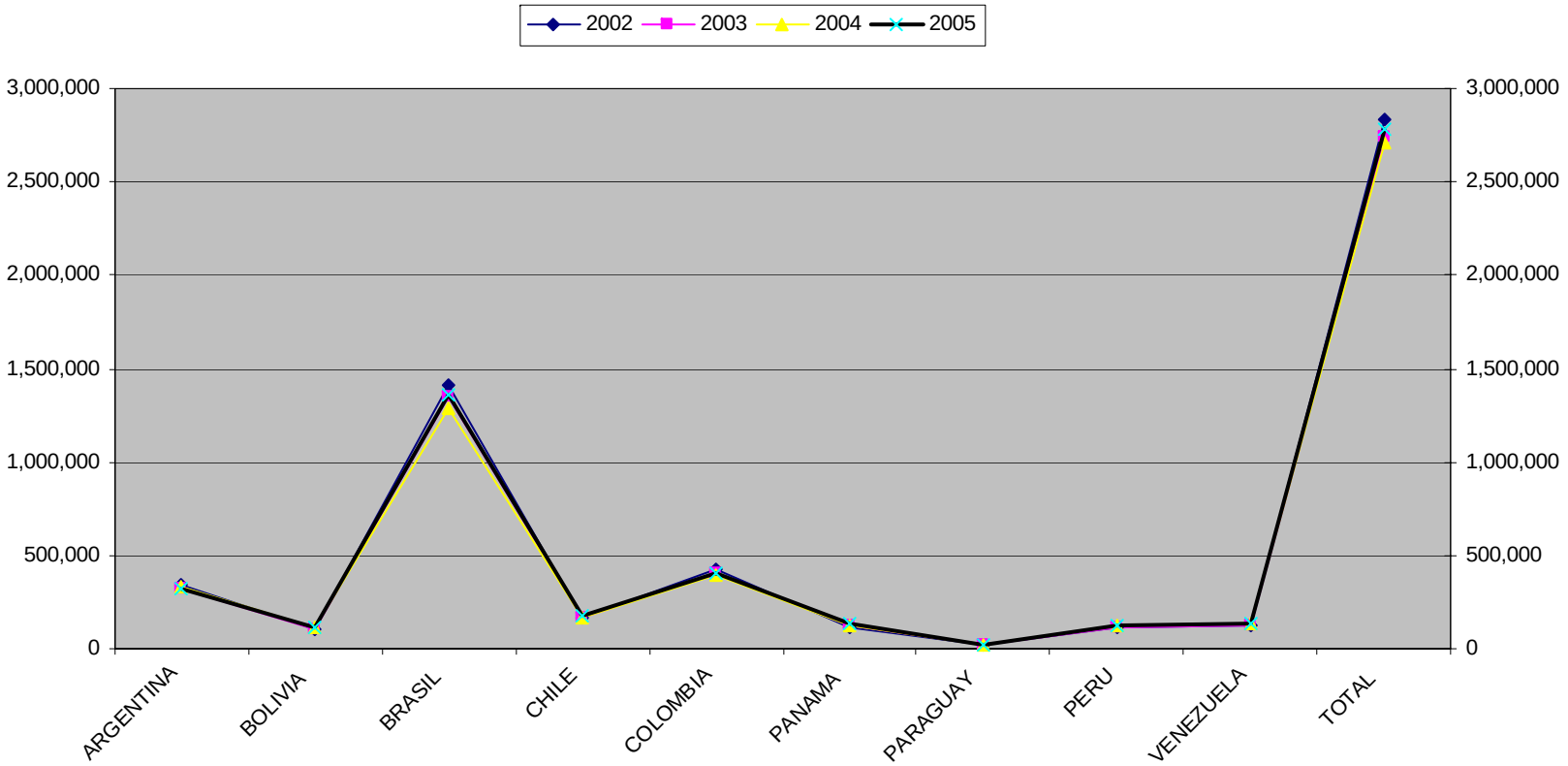
AIRCRAFT MOVEMENT IN AIRPORTS OF THE CAR REGION
PERIOD 2002 - 2005



AIRCRAFT MOVMENT IN AIRPORTS OF THE SAM REGION
PERIOD 2002 - 2005



AIRCRAFT MOVEMENT IN AIRPORTS OF THE SAM REGION
PERIOD 2002 - 2005



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APPENDIX B

Table

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

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

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

-1- Routing Area (AR)	-2- Traffic flows	-3- FIRs involved	-4- Type of area	-5- Remarks
	The Caribbean — Europe	Domingo, San Juan – EUR		
	North America – East Caribbean	New York, Miami, Havana, San Juan, Santo Domingo Piarco	Oceanic high density	West Atlantic Route System CAR/NAM inter-regional traffic flow

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APPENDIX C

General Considerations for the implementation process of a Centralized ATFM

The implementation of the Centralized ATFM should consider the following requirements:

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

b) Access to aeronautical information and cartography.

c) Access to meteorological information.

d) Database of:

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

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

f) Flight plans processing.

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

h) Automated resources:

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

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

i) Communication to coordinate with:

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

j) Human resources

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

k) Use of adequate tools for statistics

l) Infrastructure

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

m) Implementation of FMUs and/or FMPs, as required.

n) Redundancy of critical systems.

APPENDIX D

MINIMUM REQUIREMENTS FOR THE PREPARATION OF A COST-BENEFIT ANALYSIS

What is a cost-benefit analysis?

1.1 The cost-benefit analysis is the process to place numbers in a reference currency in the different costs and benefits of an activity. When using it, we may calculate the financial impact of what we wish to achieve.

1.2 It should be used when comparing costs and benefits of the different decisions. A cost-benefit analysis by itself may not be a clear guide for making a good decision. There are other items to be taken into account; for example, the workload of ATCOs, safety oversight, legal obligations, environment protection, savings produced in users' operations, etc.

1.3 Cost-benefit analysis involves 6 basic steps:

a) Gather data from important factors related with each one of the decisions. This may be accomplised in brainstroming sessions.

b) Determine costs related with each factor. Some costs, such as labour will be accurate while others will be estimated.

c) Add total costs for each proposed decision.

d) Determine benefits in a reference currency for each deicsion.

e) Place the amounts of costs and total benefits in a relationship where benefits are the numerator and costs are the denomintor:

$$\frac{\text{BENEFITS}}{\text{COSTS}}$$

f) Compare the relationship for the different proposed decisions. The best solution, in financial terms, is that with the highest relationship between benefits to costs.

INFORMATION REQUIRED FOR THE EVALUATION OF AN ATFM IMPLEMENTATION PROJECT

Following is an example of some criteria and elements that ANSPs and users would be required to contribute with the information that is required in attention to Task 1.13 – Provide information for the cost-benefit analysis" of the Action Plan for ATFM implementation in the CAR/SAM Regions.

I. By the service providers

1. Situation with and without project (Impact)

a) Current situation.
b) Situation if ATFM were implemented.

2. Techcnical-operational aspects

a) Quantification of the demand in time. Historical data and forecasts.
b) Execution phases of the project and time required for each phase (study, coordination, quotation of equipment, obtaining of resources, acquisition, arrangements in hiring of personnel, training, acquisition/offices space, installation, operation, trials).
c) Time required for the system operation.
d) Requirements of the system in the short, mid and long terms.

3. Investment

a) Value of equipment acquired, with breakdowns for each system component.
b) Useful life cycle of each component
c) Value of intangible assets of the project (software, data entry information to feed the system), feasibility studies, technical-operational training, trials.
d) Physical value of infrastructure (if available)
e) Other investments: computers, printers, photocopying machine, office furniture, fax, etc.

4. Annual expenses

a) Professional, technical and administrative and security personnel required.

   i) Provision required per specialization in function of the operational hours of the system (H-24, H-12), upon requirement or other, such as administrative schedules.

b) Operational expenses

i) acquisition of services, communications service, security, cleaning, etc.
ii) renting of offices and other facilities.
iii) Maintenance
iv) General services (in case the current provision is not sufficient):

- water
- energy supply
- cleaning
- telephone/fax

c) Supplies:

- desk supplies
- paper, etc.

II. By the users

1. Situation with and without project (impact)

a) Current situation
b) Situation if ATFM were implemented

2. Technical operational aspects

a) Assess the time demand. Historical data and forecasts.

3. Investment

a) Costs

i) Avionics equipment
ii) Supplies
iii) Planning
iv) Maintenance
v) Training
vi) Services acquisition

b) Benefits foreseen with ATFM

i) economy during flight hours
ii) expenses avoided
iii) others.

MINIMUM REQUIREMENTS FOR THE PREPARATION OF A COST-BENEFIT ANALYSIS

Following is an example of some of the criteria and elements that selected airports could require from selected airports to contribute with the information that shall be required in attention to *Task 1.13– Provide information for the cost-benefit analysis" of the Action Plan for ATFM implementation in the CAR/SAM Regions,* which the ATFM implementation groups shall execute.

Criterion	Elements
Non-regular traffic volume	Traffic arriving and departing
	Large amount of non-scheduled traffic (e.g. General Aviation)
Non-homogenous traffic mix	Integrated operations among heavy, medium and light aircraft
	Mixture of fast and slow aircraft
	Mixture of commercial and other traffic (e.g. training or General Aviation)
	Mixture of civil and military traffic
Delay situation unsatisfactory	Delays are higher than agreed with airlines as acceptable
	Delays are too high to achieve desired minimum connecting times
	Total delays per day and per month due to traffic congestion
Complex layout	Intersecting runways
	Converging runways
	Runways parallel but cannot be used independently of each other
	Aircraft need to cross active runway when taxiing
	Design permitting possible incursions in runway/taxiway.
	Complex deicing situation at airport (if applicable)
Airspace factors	Airspace surrounding airport limited, fragmented or used by neighboring airports
	SIDs and STARs over centres of population
Scope for efficiency improvement	Results achieved not sufficient relative to human resources employed
	Results achieved not sufficient relative to financial resources employed
Latent arrival capacity	Arrival demand is unsatisfied. Declared to attend arrivals capacity is sustained capacity less than existing daily normal capacity.?
Latent departure capacity	Departure demand is unsatisfied. Declared departure capacity to attend departures is less than existing daily normal capacity.?
High traffic volume	Every co-ordinated airport could be expected to have high traffic volume at least during peak periods of the day
	Estimate of traffic volume during peak hours of the day

Frequent low visibility conditions	Estimate number of days with low visibility
Technical improvements still to be implemented	Landing aids are not up to date
	Surveillance facilities are not up to date
	RNAV departures and arrivals have not been implemented
	Other facilities such as lighting, signs, etc. are not up to date and complete
Scope for improving work environment	ATCO working position does not have an optimised intelligent / ergonomic point of view, data presentation
	Tower to ground control and arrival/departure sector visibility has not been optimised (also from an ergonomic point of view)
	Social/contractual environment can be improved
Scope for optimising procedures	A strategic removal of conflicts between arrival and departure routes or sectors has not been implemented
	Reduced runway separation has not been implemented
	No adequate procedures to accelerate operations are used of aircraft in runway, keeping safety
	Conditional clearances have not been implemented
	Landing clearance is not based on adequate procedures to accelerate operations
	Non optimized runway occupancy time
	Visual turns are not carried out
Critical environmental sustainability issues	Airport in close proximity to residential areas
	Environmental regulations or constraints apply
	Major airport development envisaged

APÉNDICE / APPENDIX E

MODELO DE CATALOGO REGIONAL / REGIONAL CATALOGUE MODEL

Catálogo de los Planes de contingencia de los Estados, Territorios y Organizaciones Internacionales CAR/SAM
Catalogue of Contingency Plans of the CAR/SAM States, Territories and International Organisations

Estado State	Estado adyacente Adjacent Sate	Situación Status		Punto de Contacto Contact Point	Descripción general de facilidades y servicios que garantizan la continuidad General description of facilities and services available which ensure continuity	Observaciones Remarks
		Borrador Draft	Final			
1	2	3	4	5	6	7

Nota/Note:

Columna 1: Indicar Estado, Territorio u Organismo Internacional / Indicate State, Territory or International Organization

Columna 2: Indicar Estado, Territorio u Organismo Internacional con quien debe coordinarse el Plan de Contingencia del Estado citado en la Columna 1/ Indicate State, Territory or International Organization with whom the contingency plan of the State mentioned in column 1 should be coordinated

Columna 3: Marcar con **X** en el caso que el Plan de contingencia se encuentre en proceso para su armonización con el Estado en cuestión / Mark with an X in case the contingency plan is in process for its harmonization with the referred State.

Columna 4: Marcar con **X** en el caso que el Plan de contingencia se encuentre armonizado con el Estado en cuestión / Mark with an X in case the contingency plan is in process for its harmonization with the referred State.

Columna 5: Indicar Cargo del Punto de Contacto y medio de comunicación a utilizar en caso de ser necesario / Indicate position of the point of contact and communications means to be used, if necessary.

Columna 6: Indicar cuáles son, en general, las facilidades y los servicios disponibles mientras el Plan de Contingencia se encuentra activado / Indicate which are, in general, the facilities, available services while the contingency plan is activated.

Columna 7: Comentarios adicionales, si los hubiera / Additional comments, if any

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