ePPRC/02 — WP/05
16/10/20

SECOND GREPECAS PROGRAMMES AND PROJECTS REVIEW COMMITTEE (PPRC) VIRTUAL MEETING (ePPRC/02)
30 October 2020

Agenda Item 2: Follow-up on GREPECAS Programmes and Projects
2.4 CAR/SAM coordinated review of Projects F1 and F2: Aerodromes and Ground Aids (AGA) projects

A-CDM IMPLEMENTATION PLAN PROPOSAL

(Presented by the Secretariat)

EXECUTIVE SUMMARY	
This working paper presents a proposal for an Airport Collaborative Decision Making (A-CDM) Implementation Plan as part of the activities of GREPECAS Project F3, approved in the last CRPP / 05 by GREPECAS Member States. The proposal, initially prepared for the SAM Region, would be adjusted to incorporate the CAR Region and in accordance with the comments of GREPECAS Member States.	
Action:	The Meeting is invited to endorse the proposed Conclusion
Strategic Objectives:	• Safety • Air Navigation Capacity and Efficiency • Environmental Protection
References:	• Document 9971 - Manual on Collaborative Air Traffic Flow Management • Global Air Navigation Plan (GANP)

1. Introduction

1.1 After several activities with the aim of providing “know-how” and sensitizing the actors of the SAM Region about Collaborative Decision Making at Airport Level (A-CDM), which is part of the ASBUs of the Global Air Navigation Plan, in July 2019 the GREPECAS Program and Project Review Committee Meeting (PPRC/05) ratified Decision PPRC/05/06 that approved a new F3 Project under the GREPECAS AGA Programme related to the Implementation of A-CDM for CAR and SAM Regions.

1.2 One of the main results of the Project's Business Case was “to develop guidance material to establish common criteria for the exchange of information and the implementation of selected elements”.

1.3 The A-CDM Implementation Plan was prepared by the ICAO South American Regional Office with the support of EUROCONTROL and IATA. This Plan has been developed in accordance with the objectives of the Global Air Navigation Plan (GANP), 6th Edition and the results of the different events carried out by the SAM Office (as of December 2019, 4 events).

2. Justification

2.1 As of 2019, the growth of traffic in relation to airport infrastructure has led ICAO to design various methods such as the promulgation of new procedures, regulations, information exchange and collaborative approach in all fields to mitigate the problems faced by the aviation community in the Region.

2.2 In light of recent events such as the global COVID-19 pandemic in early 2020, the aviation industry has been hit hard. Most stakeholders advocate for a collaborative approach to concentrate efforts that could help stakeholders to know and understand the different initiatives and their impacts, to ensure an orderly and harmonized reactivation. Although the traffic levels are not the usual ones in the past, it is expected that as air operations resume, some A-CDM elements could benefit the orderly recovery.

2.3 A-CDM has been identified worldwide as a tool that allows unlocking the latent or unused capacity at the airport by increasing the situational awareness of all those involved in the operation through the exchange of information that leads to a better collaborative decision-making process, especially during the turnaround process. It has also been identified as a way to better recover from irregular operations, including natural disasters, technological disruptions, pandemics, among others.

2.4 A-CDM is part of the Aviation System Block Upgrade (GANP) methodology of the ICAO Global Air Navigation Plan (ASBU) and proposes to unlock capacity at congested aerodromes by establishing a plan to implement B0 -ACDM and subsequently selected items from B1, B2, and B3 (as required).

2.5 ICAO, in order to seek the optimization of airspace, through the GANP has established priorities such as PBN; ATFM, CDM, A-CDM and SWIM. In addition, it has established roadmaps for technology and information management to accompany the implementation of these priorities, which would achieve efficient air traffic management and airspace optimization. The goal was to ensure that the implementations are made in a scalable, secure and interoperable way.

2.6 The ICAO SAM Regional Office has been carrying out various activities in the Region since 2015 to raise awareness and provide knowledge about the A-CDM process. During these activities, the main problems identified by the participants were those in which the implementation process and / or the procedures followed are not harmonized, where there is the possibility of creating confusion among existing users, particularly aircraft operators, Air traffic control (ATC), air traffic flow management units (ATFM, when available), airport operators and ground handling agents (GHA).

2.7 Currently, in the Region a series of A-CDM implementations have been identified in the main airport hubs; however, these implementations are being carried out in a non-harmonized manner, which entails a significant risk, which, when maturing and requiring investments in systems and infrastructure, States and users of the System encounter problems of interoperability and processes. The results of a survey to the SAM States on A-CDM can be obtained at the link:

https://www.icao.int/SAM/Pages/eDocuments-v18.aspx?area=AGA&cat=ACDM

2.8 This has forced the ICAO SAM Office to initiate efforts, under the GREPECAS AGA/AOP Project F3, to encourage both States and Industry to define a common implementation approach, especially by defining a vocabulary common acronyms and methodologies in order to ensure a harmonized regional environment.

2.9 This proposed plan is also being reviewed by the Secretariat so that it is also adjusted to the CAR Region, in accordance with decision PPRC/05/06.

2.10 In order for the States to take advantage of the benefits of a harmonized and interoperable implementation in the Region, and considering the aforementioned, it is proposed to e-PPRC/02 to approve the conclusion proposed in the suggested actions (section 3 of this working paper):

3. Suggested actions:

3.1 The meeting is invited to:

a) take note of the information provided in this working paper,
b) review the content of **Appendix** , and issue comments to the Secretariat for its improvement, and
c) consider and agree to approve the following draft conclusion:

<table>
<tr><td colspan="3">Conclusion ePPRC/02/0X – Review of the A-CDM Implementation Plan Proposal</td></tr>
<tr><td colspan="2">That:
That, considering the new Project F3 on Collaborative Decision Making at the Airport Level under the Aerodrome Program, the States:
a) Endorse the first version of the A-CDM Implementation Plan proposal included in Appendix of this working paper.
b) Issue comments to the Secretariat on the A-CDM Implementation Plan proposal no later than December 4, 2020.</td><td>Expected impact:

☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Operational/Technical</td></tr>
<tr><td colspan="3">Why:
In order to have a first step to guarantee a harmonized and scalable implementation of the A-CDM concept, and its incorporation into Vol. III of the Regional Air Navigation Plan.</td></tr>
<tr><td>When:
4 December 2020</td><td colspan="2">Status:
To be endorse</td></tr>
<tr><td colspan="3">Who: ☒ States Coordinators ☒ ICAO Secretariat ☐ ICAO HQ ☐ C</td></tr>
</table>

— — — — — — — — — — —

APPENDIX

INTERNATIONAL CIVIL AVIATION ORGANIZATION
SOUTH AMERICAN REGIONAL OFFICE

SOUTH AMERICAN AIRPORT COLLABORATIVE DECISION MAKING (A-CDM) IMPLEMENTATION PLAN

[DRAFT]

This Guidance Material is approved by the GREPECAS and published by ICAO South American Regional Office, Lima

TABLE OF CONTENTS

FOREWORD

After several activities with the aim of delivering “know-how” and rising awareness to stakeholders in the SAM Region on the topic of Airport Collaborative Decision Making, which is part of the Global Air Navigation Plan ASBUs, on July 2019 the GREPECAS Programme and Projects Review Committee PPRC/5 Meeting endorsed Decision PPRC/05/06 which approved a new Project F3 under the AGA GREPECAS Programme on Airport Collaborative Decision Making for the SAM Region.

In reference to the Project’s approved Business Case, one of the main outputs was to “*develop Guidance material to establish the common rules and criteria for information exchange and implementation of selected elements*”.

The *SAM A-CDM Implementation Plan* is published by the ICAO South American Regional Office on behalf of the accredited States and International Organisations involved. This Plan have been developed in accordance with the objectives of the Global Air Navigation Plan (GANP), 6th Edition and the outcomes of consultation with States and International Organisations.

In order to ensure harmonization and reduce duplication of efforts, this Plan was prepared based on the ICAO’s Asia Pacific (APAC) A-CDM Implementation Plan. Saying this, it’s important to acknowledge the great support given to the SAM Regional Office by APAC Member States and International Organizations, including the ICAO APAC Regional Office, whose joint effort developed the APAC Plan in which this plan is referenced.

The instance for the approval of this Plan and its future versions is the [to be defined ACDM Taskforce] of the SAM Region and then GREPECAS. The ICAO SAM Regional Office will publish, on behalf of the States and International Organisations involved, revised versions of the plan as may be required to reflect current implementation activities.

Copies of the plan may be obtained from:

ICAO SAM REGIONAL OFFICE

LIMA, PERU

E-mail	:	icaosam@icao.int
Website	:	www.icao.int/SAM
Tel	:	+511 6118686
Fax	:	+511 6118689
Address	:	Apartado Postal 4127, Lima 100, Peru

Subsequent amendments and/or corrigenda will be shown in the amendment and corrigendum record table.

The publication of amendments and corrigenda is announced regularly via letters to the States and International Organisations, as well as on the ICAO website, which should be consulted by those using this publication. Blank boxes facilitate annotations.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS			
No.	Date applicable	Date entered	Entered by

CORRIGENDA			
No.	Date applicable	Date entered	Entered by

ABBREVIATIONS AND ACRONYMS

ACARS	Aircraft Communications Addressing and Reporting System
A-CDM	Airport Collaborative Decision Making
ACGT	Actual Commence of Ground Handling Time
ACISP	A-CDM Information Sharing Platform
ACZT	Actual Commencement of De-icing Time
ADIT	Actual De-icing Time
AEGT	Actual End of Ground Handling Time
AEZT	Actual End of De-icing Time
AFTN	Aeronautical Fixed Telecommunication Network
AGHT	Actual Ground Handling Time
AIBT	Actual In-Block Time
AIC	Aeronautical Information Circular
AIDX	Aviation Information Data Exchange
AIP	Aeronautical Information Publication
AIRM	ATM Information Reference Model
AIXM	Aeronautical Information Exchange Model
ALDT	Actual Landing Time
AMAN	Arrival Manager
AMHS	ATS Messaging System
AMQP	Advanced Message Queuing Protocol
ANP	Air Navigation Plan
ANSP	Air Navigation Service Provider
AO	Aircraft Operator
AOBT	Actual Off-Block Time
AODB	Airport Operational Database
AOM	Airspace Organization and Management
AOP	Airport Operations Planning
APOC	Airport Operations Centre
API	Application Programming Interface
ARDT	Actual Ready Time
ARZT	Actual Ready for De-icing Time
ASAT	Actual Start-up Approval Time
ASBT	Actual Start Boarding Time

138	ASCII	American Standard Code for Information Interchange
139	A-SMGCS	Advanced-Surface Movement Guidance and Control System
140	ASRT	Actual start-up request time
141	ATC	Air Traffic Control
142	ATCO	Air Traffic Controller
143	ATFM	Air Traffic Flow Management
144	ATFMU	Air Traffic Flow Management Unit
145	ATM	Air Traffic Management
146	ATOT	Actual Take-Off Time
147	ATS	Air Traffic Services
148	ATTT	Actual Turnaround Time
149	AXIT	Actual Taxi-In Time
150	AXOT	Actual Taxi-Out Time
151	CAR	ICAO Central America & Carribbean Air Navigation Region
152	CDM	Collaborative Decision Making
153	CHG	Modification Message
154	CONOPS	Concept of Operations
155	CTOT	Calculated Take Off Time
156	DATM	Digital ATM
157	DCB	Demand and Capacity Balancing
158	DCL	Datalink Departure Clearance
159	DMAN	Departure Manager
160	DLA	Delay Message
161	eANP	Electronic Air Navigation Plan
162	ECZT	Estimated Commencement of De-Icing Time
163	EDIT	Estimated De-icing Time
164	EET	Estimated Elapsed Time
165	EEZT	Estimated End of De-Icing Time
166	EIBT	Estimated In-Block Time
167	ELDT	Estimated Landing Time
168	EOBT	Estimated Off Block Time
169	ERZT	Estimated Ready for De-icing Time
170	ETA	Estimated Time of Arrival
171	ETOT	Estimated Take-Off Time

172	ETTT	Estimated Turnaround Time
173	EXIT	Estimated Taxi-In Time
174	EXOT	Estimated Taxi-Out Time
175	FDPS	Flight Data Processing System
176	FF-ICE	Flight and Flow Information for the Collaborative Environment
177	FIR	Flight Information Region
178	FIXM	Flight Information Exchange Model
179	GDP	Ground Delay Program
180	GHA	Ground Handling Agent
181	GREPECAS	CAR/SAM Regional Planning and Implementation Group
182	HMI	Human Machine Interface
183	IATA	International Air Transport Association
184	ICAO	International Civil Aviation Organization
185	ICD	Interface Control Document
186	ICT	Information and Communication Technology
187	IP	Internet Protocol
188	KPI	Key Performance Indicator
189	MTF	Major Traffic Flow
190	MTTT	Minimum Turnaround Time
191	NOPS	Network Operations
192	OCC	Operations Control Center
193	PDS	Pre Departure Sequencing
194	RMS	Resource Management System
195	SAM	ICAO South American Air Navigation Region
196	SESAR	Single European Sky ATM Research
197	SIBT	Schedule In-Block Time
198	SLA	Service Level Agreement
199	SMAN	Surface Manager
200	SOBT	Scheduled Off-Block Time
201	SQL	Structured Query Language
202	STD	Scheduled Time of Departure
203	SWIM	System Wide Information Management
204	TLDT	Target Landing Time
205	TMA	Terminal Control Area

TOBT	Target Off-Block Time
TSAT	Target Start-up Approval Time
TTOT	Target Take-Off Time
UML	Unified Modeling Language
VDGS	Visual Docking Guidance System
VTT	Variable taxi time
W3C	World Wide Web Consortium
XML	eXtensible Markup Language

1. Chapter 1: Introduction

1.1 Background

1.1.1 Based on the ***Declaration to promote Connectivity through the Development and Sustainability of Air Transport in the Pan-American Region - Vision 2020-2035 (IWAF/4)***, endorsed by Pan-American States in Fortaleza, Brazil in September 2018, the sustainable development of aviation in the Region depends on the availability of capacity and efficiency of its operations, through coordinated actions, in alignment with the ICAO Global Air Navigation Plan (GANP). Airports are an important link in the process to ensure the needed capacity and efficiency for aircraft operations to occur.

1.1.2 Due to the fact that infrastructure bottlenecks at airports will not be solved on the short term, it's important to operate as efficient as possible with the current facilities. The efficiency of the Air Transport System in the Region depends highly on traffic predictability.

1.1.3 The traffic growth vis-a-vis airport infrastructure has prompted ICAO to devise various methods like promulgation of new procedures, regulations, sharing of information and collaborative approach in all fields to mitigate the issues being faced by the aviation community in this region.

1.1.4 In light of events such as the World Pandemic of COVID-19 in 2019-2020, the aviation industry had been strongly affected. Most Stakeholders advocate for collaborative approach for focusing efforts that could help the stakeholders in knowing and understanding different initiatives and their impacts, to ensure an orderly and harmonized reactivation.

1.1.5 A-CDM has globally being identified as a way to unlock latent or unused capacity in the airport by means of increasing situation awareness to all the involved stakeholders thru sharing of information that leads to a better collaborative decision making process, especially during the turnaround process in the airport. It has also being identified as a way to better recuperate from irregular operations, including natural disasters, technological disruptions, among others.

1.1.6 A-CDM is part of the ICAO's Global Air Navigation Plan's Aviation (GANP) System Block Upgrades (ASBU) methodology and it proposes to increase airport capacity in congested aerodromes by establishing a plan to implement B0-ACDM and subsequently selected elements of B1, B2 & B3 (as needed).

1.1.7 The ICAO SAM Regional Office has been conducting several activities in the Region since 2015 to raise awareness and deliver know-how on the Airport Collaborative Decision Making process. By these activities, the main issues observed were regarding wherever the implementation process and / or the procedures being followed are not harmonised wherein the possibility of creating confusion amongst the existing users particularly aircraft operators, Air Traffic Control (ATC), Air Traffic Flow Management units (ATFM, where available), airport operators and Ground Handling Agents (GHA).

1.1.8 This has necessitated ICAO SAM Office to begin efforts to encourage both States and Industry to define a common approach to implementation, especially by means of defining a common vocabulary of acronyms and methodologies in order to ensure a harmonized regional environment.

1.1.9 This document is a proposal to address this matter. It was developed by experts nominated by States, International Organisations (CANSO, ACI, IATA, EUROCONTROL) in order to foster harmonized and interoperable A-CDM in the SAM Region.

1.2 Scope

1.2.1 This plan is intended to cover the basics for the harmonized implementation of B0/1-ACDM "Airport CDM Information Sharing" in order to accomplish its main purpose of generate common situational awareness, which will foster improved decision making within aerodromes, by sharing relevant surface operations data among the local stakeholders involved in aerodrome operations.

1.2.2 The plan, along with other activities such as the creation of a community or working group to generate discussions on the matter, seeks to enable new capabilities in which Stakeholders will be able to collaborate and take actions towards the achievement of a set of defined milestones, by being aware of the status of an individual flight measured against known target times and milestones.

1.2.3 In future editions, this plan may evolve and include guidance for the implementation of B0/2-Integration with ATM Network function and subsequent B1, B2 & B3 when available. This is why it's important for stakeholders, especially airport operators, to consider the need for their processes and systems to have the capability to integrate to the ATM network, including national or regional ATFM services.

1.2.4 After the analysis of a survey on A-CDM implementation requested to States on August 2019 (see Chapter 5), the initial scope of this plan will be on the on-going implementation efforts and short-term implementation on the Region's main hubs.

1.2.5 Although many States already engage on implementation on both international and domestic airports, the scope of this guidance will be tailored to benefit the implementation on international aerodromes. A list of the top international aerodromes based on 2019 departures is listed on Table 1.1.

Table 1.1 – List of top international aerodromes (one per State) departures per year in 2019

Rank	State	City	Airport Name	Airport code	2019 Departures	2018 Pax Traffic
1	Brazil	Sao Paulo	Guarulhos Intl.	SBGR	146,132	43M
2	Colombia	Bogota	El Dorado Intl	SKBO	142,578	34.9M
3	Peru	Lima-Callao	Jorge Chavez Intl	SPIM	96,867	23.7M
4	Chile	Santiago	Arturo Merino Benitez Intl	SCEL	74,147	24.6M
5	Panama	Panama City	Tocumen Intl	MPTO	71,154	16.5M

1.2.6 It is important to note that the SAM Region have not agreed on a criteria for airports to implement A-CDM. The definition of when and how to implement A-CDM was discussed on the 4th SAM A-CDM Seminar (see Summary of Discussion on the event website at https://www.icao.int/SAM/Pages/MeetingsDocumentation.aspx?m=2019-06901-ACDM4). Nowadays, there is no regional agreement on a "number" to decide for the need to implement A-CDM, for example, number of passengers per year, operations or departures. It was indicated at the Event that the level of "distress" or "depletion" of airport infrastructure vs # of airport operations might be a good number, as also the number of delays and high taxi times. For example, airports like London Gatwick in the United

Kingdom in 2019 achieved around 46.6 million passengers and almost 283k operations with a single runway, thanks in part of A-CDM in place.

1.2.7 A complete gap analysis and Cost benefit analysis are good tools to identify the need to implement. This is especially true for airports that may not qualify to a prescriptive criteria such as passenger or traffic figures, but that serve as “feeder” airports to a main hub, as cases explained by Colombia and Peru.

1.3 The regional setting

1.3.1 In our Region, the stakeholders, including regional air navigation implementation groups, aerodrome operators, air navigation service providers, regulatory bodies, international organizations, industry and manufacturers, will be facing higher levels of interaction when implementing this concept.

1.3.2 States, air service operators and the industry will benefit from this plan and from the availability of international guidance material (SARPs) related to A-CDM, since they will permit the implementation of a more efficient, economical and efficient aviation system in our Region.

<u>CARSAM Planning and Implementation Regional Group - GREPECAS</u>

1.3.3 GREPECAS planning will take place at the strategic level, in support of ICAO strategic objectives set forth in the GANP. This regional group will actively participate in the coordination and harmonisation of all activities carried out for the implementation of the approved regional air navigation plan.

1.3.4 GREPECAS will facilitate the exchange of best practices, cooperation, and collaboration by applying a top-down approach to supplement the bottom-up planning and implementation approach of the SAM States and Region. GREPECAS activities will be fully aligned with GANP objectives, while ensuring that the Air Navigation priorities of the SAM Region are taken into consideration. Likewise, the GREPECAS will monitor the implementation efforts of the eANP and subsequent elements.

1.3.5 The GREPECAS will also facilitate the sharing and exchange of information with SAM States.

<u>ICAO South American Regional Office</u>

1.3.6 The South American Regional Office will conduct its A-CDM planning and implementation at a strategic level, and will provide support to the States at a tactical level for the achievement of their objectives and targets.

1.3.7 The SAM Office will provide support to the States in the planning and implementation of their national plans. To provide this support, the Regional Office will coordinate with the corresponding States the necessary virtual and on-site technical assistance by its officers and other selected experts.

<u>Regional Project RLA06/901</u>

1.3.8 Provide support and funding of related activities that support States implementation of the Regional Air Navigation Plan, including A-CDM.

A-CDM Regional Task Force

1.3.9 Participants of our 4th A-CDM SAM Seminar (November 2019) agreed on the convenience of establishing a Regional A-CDM Task Force, with ICAO Secretariat support, that could address the aspects of the regional A-CDM implementation. This group should comprise of technical focal points per State and per some international airports, ANSPs and aircraft operators in order to ensure the full scope of A-CDM. Nevertheless, it was mentioned that care should be taken in order to keep the group as technical as possible. The Task Force can create smaller working groups to see specific topics such as IT.

1.3.10 This group will work on the technical level of the programme, serving as an experts panel to discuss the harmonization challenges and opportunities in order to ensure both scalability and harmonization in the Regional A-CDM implementation efforts.

1.3.11 The governance and terms of references for this group will be defined and align with the work of this guide.

1.4 Executive Summary

1.4.1 As part of the Project F3: Airport CDM approved by GREPECAS under Meeting PPRC/5 (2019), the ICAO SAM Regional prepared a survey to Member States on A-CDM implementation. Taking reference to survey data collected from States/Administrations regarding the status of A-CDM implementation and the discussion deliberated in the past SAM A-CDM seminars for the need of harmonisation on A-CDM in the SAM Region, especially for the process of implementation, data sharing, terminologies, data formats and framework of interoperability with other related systems.

1.4.2 The SAM A-CDM Implementation Plan shares insights in the following areas for assisting States in planning and implementation of A-CDM in different stages.

<u>A-CDM Phases</u>

1.4.3 A-CDM project activities could be grouped into the following three phases:

- Initiation;
- Implementation; and
- Operation and Monitoring.

1.4.4 In the Initiation Phase, it is required to define the need and complete relevant analysis in order to make a decision for the implementation of A-CDM.

1.4.5 In the Implementation Phase, variety among A-CDM projects in different airports is expected due to the involvement of a broad mix of stakeholders with relatively unique operationing requirements. However, the following key considerations are interpreted as commonalities among A-CDM projects:

- Clear definition of roles and responsibilities among stakeholders;
- Establishment of A-CDM Project Management Team;
- Stakeholders' access to A-CDM data;
- Aim to achieve an effective and efficient turnaround process; and
- Development of continuous improvement culture.

1.4.6 In the Operation and Monitoring Phase, focus will remain on continuous improvement and development of the A-CDM system and process to optimize the utilization of the airport infrastructure. It is crucial to define key performance indicator measurements related to TOBT and TSAT for evaluating effectiveness of A-CDM implementation.

<u>Harmonization Framework</u>

1.4.7 It is understandable that each individual airport can maintain its unique requirements in implementing A-CDM. To a certain extent, the need for harmonization on the following aspects is also anticipated. Relevant reference and guidance have been laid out in the SAM A-CDM Implementation Plan.

- A-CDM terminologies and definition;
- Roles and responsibilities of A-CDM stakeholders;

- Standardization of A-CDM procedures; and
- Commonality in milestone approach.

Interoperability of A-CDM with other systems

1.4.8 Making reference to the ICAO Aviation System Block Upgrades (ASBU) framework, it is considered necessary to link up relevant ASBU modules and elements related to A-CDM, the application of SAM Region Digital Network (REDDIG) and System-Wide Information Management (SWIM) for carrying regional information exchange models such as FIXM, etc.

1.4.9 There should be a project framework for integration/interoperation of A-CDM with other air traffic management (ATM) systems, especially for ATFM platform, in accordance with the ASBU roadmap. A good practice for development and implementation of interoperability among A-CDM and ATFM platforms should incorporate considerations of relevant milestones involved, open standards for sharing data with systems across border, alignment of compliance criteria in A-CDM and ATFM, and coordinated timing for data exchange matched with data availability timeline.

1.4.10 New and on-going A-CDM implementations must consider not only current ways of communicating with ANSP and other users, with systems such as AFTN/AMHS, but also considering the future exchange models suchs as FIXM, AIXM, IWXXM, AIDX, etc., all based on .xml and that will become the replacement for legacy or teletype based applications.

1.4.11 The above was addressed as one of the main challenges to be considered by implemention efforts.

Research and Future Development

1.4.12 A-CDM has its roots in Europe and is the foundation for Single European Sky ATM Research (SESAR) concept for use of better data and technology to make aircraft and airport operations more efficient. However, not all regions have a centric ATM network as Europe so the processes would be different in the SAM Region. As air traffic management evolves and additional concepts are being introduced by the industry, changes and adjustments to A-CDM are anticipated. One example is what participants on the 4th A-CDM SAM Seminar refer as “feeder” airports. Those are airports that may not need to implement the full scope of A-CDM, but that will benefit the A-CDM implementation of the hubs they feed if they manage to monitor certain elements and milestones of the A-CDM process. A concept for “feeder” airports will be discuss on this guidance.

1.4.13 To assist in making the implementation of A-CDM more successful, it is recommended that a regional ATFM environment be established e.g. via a distributed multi-nodal ATFM network, which would enable a certain degree of harmonization and provide consistency for stakeholders. Currently, under the efforts of GREPECAS and SAMIG (SAM Implementation Group) there are efforts on this matter.

2. Chapter 2: A-CDM Implementation guidance

2.1 Overview of A-CDM

2.1.1 Airport collaborative decision-making (A-CDM) is a set of processes developed from the general philosophy of collaborative decision-making (CDM) in aviation and is applied to the operations at aerodromes.

2.1.2 A-CDM can optimize airport operations, by enhancing the turnaround process and improving flight predictability through real time data exchange for all A-CDM stakeholders. A-CDM also potentially helps to improve gate/aircraft stand management, reduce apron taxiway and holding point congestion. A-CDM involves implementing a set of operational procedures supported by sharing of timely and accurate information amongst A-CDM stakeholders. Overall, A-CDM is about making more efficient use of existing capacity and resources, as well as potentially better recovery from disruptions. A-CDM can, in some cases reduce operating cost attributed to fuel burn, which contributes to environmental benefits.

2.1.3 Any implementation of A-CDM must be based on assessment of current operational constraints and the value that an A-CDM implementation will generate to mitigate such constraints and / or improve current operations. There is a set of essential elements as well as best practices to consider when implementing A-CDM that will simplify and harmonize the implementation. These elements must be implemented in a prescribed manner to be effective. However, each implementation must be based on careful engagement across all airport stakeholders, primarily the Airport Operator, Aircraft Operators, Ground Handling Agents, Air Navigation Service Provider and Air Traffic Flow Management Unit (if any).

2.1.4 Prior to A-CDM, the stakeholders worked on the basis of “first come first served” in the start-up sequence of aircraft. A-CDM works on the premise of “best planned best served”, whereby ATC will optimise the pre-departure sequence, by generating Target Start-up Approval Times (TSAT), using Target Off-Block Times (TOBT) submitted by Aircraft Operators or their delegate (e.g. Ground Handling Agents). It is a collaborative approach amongst all the A-CDM stakeholders and the success is ultimately dependent on the **accuracy and quality** of TOBTs which are managed by Aircraft Operators.

2.1.5 To aid the generation of accurate TOBTs and TSATs in the A-CDM process, timely and accurate information updates are very important. The key information needed is ELDT, EIBT, ALDT and AIBT from the arriving flight that is linked to the departing flight. Timely update of this information is related to the A-CDM milestones.

2.2 A-CDM Project Phases

2.2.1 A-CDM project activities may be grouped into three phases as illustrated in Figure 2-2:

- Initiation;
- Implementation; and
- Operation and monitoring.

- Initial familiarization on A-CDM
- Stakeholder consultation
- A-CDM Gap Analysis
- Cost Benefit Analysis (CBA)
- Draft governance structure
- MOU between all stakeholders
- Requiremente definition
- Procurement (if needed)
- High-level implementation plan

Governance
- Establish Steering Group
- Set-up Project organization (roles & responsibilities)
- Develop detailed implementation plan
- Establish communication plan
- Establish Training plan
- Establish data sharing agreement

A-CDM Operations
- Develop A-CDM procedures
- Carry out stakeholder workshops/training and the changes it wil introduce
- Establish Measurement Framework
- Implement A-CDM solution
- Adapt necessary systems to provide/receive A-CDM data
- Plan and carry out trials

- Establish necessary framework to maintain A-CDM operations with roles and responsibilities
- Follow-up A-CDM compliance and performance to ensure procedures are followed and objectives met
- Adjust procedures, as and when needed.

Figure 2-2 - A-CDM Project Phases

2.2.2 The initiation phase is about defining the need, including gap analysis, making the cost and benefit analysis, and ultimately getting a decision to go ahead to invest in the implementation phase.

2.2.3 During this initial phase, is important to review the current procedures and systems that each stakeholder has, and how these may communicate to share information. When implementing, it is important to realise the benefit of integrating several sources of information in an automated way to facilitate collaboration. This may raise integration/interface costs for the project.

2.2.4 The project implementation phase is to undertake the activities to successfully carry out the A-CDM project, which is different from many other implementation projects due to its multi-stakeholders' involvement and impact on operations.

2.2.5 The operations phase is about when A-CDM is up and running.

2.2.6 This plan focuses on highlighting some of the most critical activities to consider in the implementation phase.

2.3 Key Considerations for A-CDM Implementation Phase

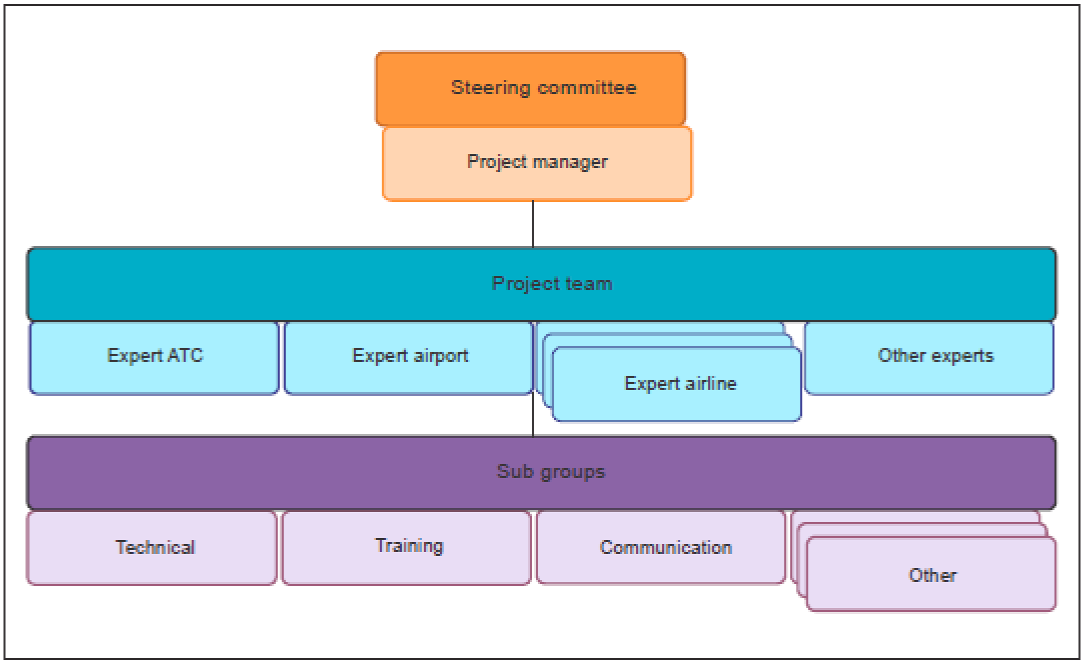

Figure 2-1: example of an A-CDM project organization (taken from Doc9771)

2.3.1 A-CDM Steering Group comprising of all relevant stakeholders, which is a minimum of the Airport Operator, Ground Handling Agents, ANSP and Aircraft Operators, should be set up before any implementation, with the responsibility to agree on the A-CDM processes, procedures, performance framework, data sharing and common definitions. Generally, this is initiated by the Airport Operator.

2.3.2 The A-CDM Steering Group should define clear roles and responsibilities in the implementation phase for the A-CDM stakeholders, i.e. “who” is doing “what” and “when” in the implementation project. This is not to be confused with the “roles and responsibilities” of the stakeholders in the A-CDM process, which is something different and addressed in the “Harmonization Framework” section.

2.3.3 A-CDM Project Management Team should be established and involve all A-CDM stakeholders during design and implementation of A-CDM project.

2.3.4 Ensuring early engagement with stakeholders and installing a collaborative culture will support the success of an A-CDM implementation. This process should create clarity across A-CDM stakeholders on the objectives of the implementation, and the expectations from each party. With clear and agreed objectives across all key stakeholders, A-CDM implementation should yield projected benefits and will prevent sub-optimal operations or limited return on investment for the airport.

2.3.5 As A-CDM is a change in procedures, it can also be a huge cultural and behavioural change for all A-CDM stakeholders that should not be underestimated. In order to address this challenge, appropriate communication and training plans should be put in place to facilitate the understanding and impact of A-CDM for each stakeholder.

2.3.6 Local A-CDM Operational Procedures should be developed in collaboration with the stakeholders. These procedures needs to detail at a minimum roles and responsibilities, i.e. "who is doing **what, when and how"** in the A-CDM process. During this work implementers should look to other A-CDM procedure manuals and related materials to leverage experience gained and lessons learnt.

2.3.7 The implementation should be in a phased approach, including trials, with a minimum of disturbance to A-CDM stakeholders' operations.

2.3.8 A framework of reviews to track progress of A-CDM implementation should be created by the A-CDM steering group. This framework aims to ensure that the implementation phase timelines and objectives are met.

2.3.9 Performance framework to measure key performance indicators should be established as early as possible in the implementation phase.

2.3.10 Wherever ATFM is operational, it is desirable to integrate with local A-CDM to achieve optimal situational awareness for all stakeholders.

2.4 Stakeholder Access to A-CDM Data

2.4.1 A-CDM requires airport stakeholders to exchange timely operational information which enables collaboration in the efficient management of operations at an airport.

2.4.2 Data exchanges via the common interfaces should support the entire data related to A-CDM elements and milestones. Full scope messaging will provide context to enhance situational awareness.

2.4.3 Some of the Stakeholders may have systems set-up with different acronyms or milestones in respect to the ones agreed by the A-CDM Project implementation group. Special care should be taken to ensure access to the data of these sources.

2.4.4 As for now, there is no common agreed Information Exchange Model by ICAO to share A-CDM data, however, the industry, mainly IATA and ACI, have agreement on the use of Aviation Information Data Exchange (AIDX) as a data exchange model of A-CDM data among stakeholders using commercial flight identification (outside the ATM domain). AIDX is an eXtensible Markup Language (XML) messaging standard for exchanging flight data among airlines, airports, ground handlers and other third party data consumers.

2.4.5 In the future, FIXM (Flight Information Exchange Model), the model indentified by ICAO as the one that will be used on the ATFM domain of a Flight , will address A-CDM; therefore, FIXM shall be at least semantically consistent with AIDX, in case of overlap of information. [1]

2.4.6 The adoption of an open source platform for an A-CDM Information Sharing

[1] The FIXM Strategy; https://www.fixm.aero; version 1.0, Feb. 2014

Platform (ACISP) is encouraged in order to reduce the license cost to A-CDM stakeholders wishing to implement data exchange via the common Application Programming Interface (API).

2.4.7 Consideration shall be given to those stakeholders, such as general aviation, that may need a common use interface to input/read A-CDM related information to/from the ACISP. This may be done by Human Machine Interfaces (HMI), websites, Open API's, or by reporting it to the Airport Operations Center (APOC) via radio or phone communications, following an agreed procedure to do so.

2.5 Achieving an Effective and Efficient Turnaround Process

2.5.1 The turnaround process encompasses the complete management of an aircraft from the arrival at an airport to the departure (from AIBT to AOBT) that needs to be effective and efficient in order to contribute to a successful A-CDM implementation.

2.5.2 The A-CDM turnaround process involves stakeholders, operational services, data points and algorithms that are instrumental to successful turnaround of an aircraft.

2.5.3 To ensure good interaction amongst stakeholders the understanding, management and <u>ownership of the TOBT is of utmost importance</u>. Many airports around the world are calculating "Predicted-TOBTs" but it's worth making the point that these are distinct from the TOBT as ultimately the Aircraft Operator (or delegated to its ground handler) is the only stakeholder that can manipulate it's operation and determine the real TOBT. This will improve performance of the turnaround.

2.5.4 A departure sequence capability should be introduced that produces Target Start-up Approval Times (TSATs) and Target Take Off Times (TTOTs). This is to deliver transparency, better recovery and improvements to Calculated Take-Off Time (CTOT) compliance. The capability should evolve with the A-CDM implementation and the "Operation and Monitoring" phase.

2.5.5 The Variable Taxi Times (VTTs) are of utmost importance for the A-CDM processes to work, including producing automated updates to Estimated In Block Times (EIBTs) as well as the Target Start-up Approval Times (TSATs) and Target Take Off Times (TTOTs). The practical implementation of VTTs can vary from static values (e.g. fixed taxi times from runways to individual gates or blocks of it) to highly dynamic VTTs that take ground movement patterns, changes at the airfield and changes to traffic flows due to weather into account. How advanced and dynamic, the VTTs need to be considered in the implementation where the complexity of traffic patterns and airport layout are factors to be considered. The more accurate the VTTs are the better the overall predictions and sequencing of traffic will be.

2.5.6 The Minimum Turn-Round Time (MTTT) is also very important for the A-CDM processes to work. It comes into play to help calculating Target Off Block Times (TOBTs) based on Estimated In Block Times (EIBTs) or Actual In Block Times (AIBTs). The MTTTs will depend on factors such as aircraft type, possibly type of stand, airline procedures, destination etc. The values and implementation of MTTTs should be discussed in close cooperation with the Airline Operators to ensure accurate values are used. MTTTs not representative of the operations will result in less accurate TOBTs as well as TSATs and TTOTs, as long as TOBTs are not manually controlled by the Airline Operator or Ground Handling Agents.

2.6 Building a Continuous Improvement Culture

2.6.1 A-CDM implementation involves the interaction of multiple stakeholders, processes and systems. A culture of continuous improvement amongst all stakeholders will benefit all involved.

2.6.2 Following its implementation, the environment at an airport will change and may require adjustments in the A-CDM processes.

2.6.3 After A-CDM implementation, it is important that the focus remains on continuous improvement and developing the overall A-CDM system to ensure optimized utilization of airport infrastructure. The project should be able to support a suitable improvement mechanism.

2.6.4 All stakeholders should be able to monitor improvements from an A-CDM implementation. This should consist of:

a) Exchange of experience at regular intervals.
b) Ad-hoc meetings before any major release of new software or update of the A-CDM implementation (procedural or functional). Ideally, this should be supported by a consensus achieved by discussion amongst impacted stakeholders.
c) ICAO SAM Regional Office can be approached to solicit views on new implementations or improvement opportunities.

2.6.5 Where ATFM exists, the Airport-CDM and ATFM should collaborate to improve airport operations especially for capacity planning and impact of performance degradation at other airports.

2.7 Measure Effectiveness of A-CDM Implementation

2.7.1 With the implementation of A-CDM there will be a change from current operating procedures as it introduces two new time elements, namely Target Off Block Times (TOBTs) and Target Start-up Approval Times (TSATs) and the procedures around these time elements. More specifically the operational changes relates to:

- The management, including input and updates as needed, of Target Off Block Times (TOBTs) for either the aircraft operator or the ground handler.
- The management, including input and updates as needed, of TSATs for the Air Navigation Service Provider (ANSP)
- The start-up and push back procedures.

2.7.2 It is very important that the impacts of these procedure changes are measured so that the effectiveness of the A-CDM implementation can be assessed. This will allow all stakeholders to effectively monitor how the A-CDM procedures are complied with, and identify where improvement can be made, which is just as important as getting A-CDM implemented in the first place.

2.7.3 Key performance indicators (KPIs) related to TOBT and TSAT are required to assess the effectiveness of an A-CDM implementation.

2.7.4 Other KPIs may be used as supplement for monitoring the performance of the A-CDM.

Measurements of TOBT

2.7.5 Achieving inputs and updates of TOBT as accurate as possible is one of the first steps in the A-CDM implementation. The Aircraft Operators or Ground Handling Agents will need to provide a TOBT for all departing flights to enable the A-CDM procedures to flow efficiently and effectively. Without TOBT, there will be no predictability of departure readiness and TSAT will not be available.

2.7.6 The following measurements are related to TOBT.

Table 2-1 – Measurement of TOBT

Name of the indicator	**TOBT input participation rate**
Value of indicator	Allows the A-CDM project team to see the amount of participation from airlines/ground handling agents in TOBT inputs before proceeding to measure the accuracy and use TOBT for pre-departure sequencing.
Data requirement	Manual TOBT updates/inputs
Formula	Track number of TOBT inputs from each airline and ground handling agent through different time references before departure, e.g. at TOBT-10mins, -20min and -40mins
Indicator forms	Participation rate in TOBT inputs and when does it occur
Tips/Warnings	It is important to achieve a high % of participation in order for the A-CDM concept to work. A-CDM with low participation rate will lead to questions on fairness when TSAT is used for pushback and eventually the collaborative concept may fail. To improve participation rate, more A-CDM awareness workshops or compliance measures may be required.
System Requirements	Data analysis tool of the A-CDM portal if available or TOBT input records

Table 2-2 – Accuracy of TOBT

Name of the indicator	**TOBT Accuracy**
Value of indicator	Allows airlines/ground handling agents to understand whether their TOBT submission workflow/process is effective in achieving an accurate TOBT. Allows the A-CDM project team to assess whether the TOBT quality is acceptable and can be used to generate TSAT. It also gives a general indication of compliance rate for TOBT submission.
Data requirement	• TOBT • Actual Ready Time (ARDT) and/or Actual start-up request time (ASRT)
Formula	• Compare TOBT against ARDT and/or ASRT • Compare TOBT against AOBT
Indicator forms	• Accuracy of TOBT • TOBT compliance rate

Tips/Warnings	Low TOBT accuracy with high TOBT participation rate indicates that the airline/ground handling may have to improve their internal workflow/process for updating of TOBT. How to measure the accuracy of the TOBT depends on the procedures applied for the A-CDM implementation. To be able to measure the TOBT accurately, it is highly recommended that pilot shall call ready within an agreed window of the TOBT and that ATC indicates this time via an ARDT or ASRT.
System Requirements	• Data analysis tool of the A-CDM portal if available or TOBT input records • AOBT from appropriate source ARDT and/or ASRT from an Electronic Flight Strip system or alternative means.

Note: *Some European airports benchmark their TOBT compliance at 80%.*

Measurement of TSAT

2.7.7 A Pre-Departure Sequencer/Departure Manager solution might be used for pre-departure sequencing in the A-CDM implementation, which should be generating an optimal TSAT to achieve the best sequence to maximize runway throughput and regulate traffic to a holding point. However, if ATC or pilots are not adhering to the TSAT, the benefits will not be achieved.

2.7.8 TSAT compliance plays an important role in achieving the objective of reducing taxi-out time and also shows the level of commitment to TSAT in the A-CDM procedures.

2.7.9 Consideratios of TSAT adherence and TOBT quality may need to be addressed on the MoU drafting, including actions in case none of this is followed.

Table 2-3 – Measurement of TSAT

Name of the indicator	**TSAT Compliance**
Value of indicator	Allows the A-CDM project team to assess whether ATC is following the TSAT for pushback and also pilots' adherence to the TSAT procedure.
Data requirement	• TSAT • Actual Start-up Approval Time (ASAT) • AOBT
Formula	• Compare ASRT and/or ASAT against TSAT • Compare AOBT against TSAT
Indicator forms	• TSAT compliance rate

Tips/Warnings	If the compliance level is low, it may mean either the A-CDM procedures are not followed by ATC/Pilots or ATC did not enforce TSAT compliance or the TOBT submitted by airlines/ground handling agents is not up to desired accuracy. In addition, PDS processes may need to be reviewed if TSAT's generated can be complied. How to measure the compliance to the TSAT depends on the procedures applied for the A-CDM implementation. To be able to measure the compliance it is highly recommended that pilot request within a window of the TSAT and that ATC indicates this time via an ASRT. ATC shall also give the start-up approval within the given TSAT window and indicate this via an ASAT
System Requirements	• Data analysis tool of the A-CDM portal if available or TSAT records from DMAN/PDS • AOBT from appropriate source • ASRT and/or ASAT from an Electronic Flight Strip system or alternative means.

Note: *Some European airports benchmark their TSAT compliance at 80%.*

3. Chapter 3: Harmonization Framework

3.1 A-CDM Terminologies (vocabulary) and Definitions

3.1.1 As more and more airports adopt A-CDM, it is important that implementations strive for harmonization with respect to certain areas. This relates to certain procedures, roles and responsibilities as well as having common understanding of terminologies.

3.1.2 Groups with limited interaction often develop their own semantic references; airport stakeholders are not an exception as they may use different terminologies to cover the same reality. A lack of common definitions and understanding of terms across the stakeholder community can exacerbate misunderstanding and contribute to the lack of common situational awareness.

3.1.3 As example, “arrival time” to an air traffic controller (ATCO) could mean at the point of touchdown, whereas for an airline or ground handling agencies “arrival time” may be understood as the time when an aircraft is at the gate. This disparity in a common definition of terms leads to a lack of shared awareness and clarity of the operational picture, which can lead to confusion and result in increased inefficiencies.

3.1.4 This has been addressed by participants of the 4th A-CDM SAM Seminar as one of the biggest and main focus areas on A-CDM implementation.

3.1.5 As A-CDM brings stakeholders together as part of the procedures and collaboration, it is of highest importance to implement common acronyms and definitions that are agreed and understood by all. To ensure harmonization not only at the local airport level in an A-CDM implementation but at the regional South American (SAM) level the following A-CDM definitions are highly recommended to be adopted as part of an A-CDM implementation.

3.1.6 These acronyms and definitions are aligned with overarching ICAO definitions, where applicable, as well as EUROCONTROL A-CDM acronyms and definitions.

Table 3-1 – A-CDM Acronyms and Definitions

Acronyms	Definition	Explanation
ACGT	Actual Commence of Ground Handling Time	The time when ground handling on an aircraft starts, can be equal to AIBT (to be determined locally)
ACZT	Actual Commencement of De-icing Time	The time when de-icing operations on an aircraft starts
ADIT	Actual De-icing Time	The actual time that the de-icing activity takes. Metric AEZT – ACZT
AEGT	Actual End of Ground Handling Time	The time when ground handling on an aircraft ends.
AEZT	Actual End of De-icing Time	The time when de-icing operations on an aircraft end
AGHT	Actual Ground Handling Time	The total duration of the ground handling of the aircraft. Metric ACGT -

Acronyms	Definition	Explanation
		AEGT
AIBT	Actual In-Block Time	The time that an aircraft arrives in-blocks.
ALDT	Actual Landing Time	The time that an aircraft lands on a runway.
AOBT	Actual Off-Block Time	Time the aircraft pushes back /vacates the parking position.
ARDT	Actual Ready Time	When the aircraft is ready for start-up/push back or taxi immediately after clearance delivery, meeting the requirements set by the TOBT definition
ARZT	Actual Ready for De-icing Time	The time when the aircraft is ready to be de-iced
ASAT	Actual Start Up Approval Time	Time that an aircraft receives its start-up approval
ASBT	Actual Start Boarding Time	Time passengers are entering the bridge or bus to the aircraft
ASRT	Actual Start Up Request Time	Time the pilot requests start up clearance
ATOT	Actual Take-Off Time	The time that an aircraft takes off from the runway.
ATTT	Actual Turnaround Time	Time taken to complete turnaround. Metric AOBT – AIBT
AXIT	Actual Taxi-In Time	Time taken to taxi to stand after landing Metric AIBT – ALDT
AXOT	Actual Taxi-Out Time	Time taken from pushback to take-off Metric ATOT – AOBT
CTOT	Calculated Take-Off Time	A time calculated and issued by the appropriate air traffic management unit as a result of tactical slot allocation, at which a flight is expected to become airborne
ECZT	Estimated Commencement of De-icing Time	The estimated time when de-icing operations on an aircraft are expected to start
EDIT	Estimated De-icing Time	Metric EEZT – ECZT
EEZT	Estimated End of De-icing Time	The estimated time when de-icing operations on an aircraft are expected to end
EIBT	Estimated In-Block Time	The estimated time that an aircraft will arrive in-blocks. NOTE – This can sometimes

Acronyms	Definition	Explanation
		be referred to as Estimated Time of Arrival (ETA) by Aircraft Operator. It is important to clarify the ETA in relation to EIBT and ELDT.
ELDT	Estimated Landing Time	The estimated time that an aircraft will touch-down on the runway. NOTE – This can sometimes be referred to as Estimated Time of Arrival (ETA) by ATC. It is important to clarify ETA in relation to EIBT and ELDT.
EOBT	Estimated Off-Block Time	The estimated time at which the aircraft will start movement associated with departure; also associated with the time filed by aircraft operator in the flight plan
ERZT	Estimated Ready for De-icing Time	The estimated time when the aircraft is expected to be ready for de-icing operations
ETOT	Estimated Take-Off Time	The estimated take off time taking into account the EOBT plus EXOT.
ETTT	Estimated Turnaround Time	The time estimated by the AO/GHA on the day of operation to turn-round a flight taking into account the operational constraints
EXIT	Estimated Taxi-In Time	The estimated taxi time between landing and in-block
EXOT	Estimated Taxi-Out Time	The estimated taxi time between off-block and take off. This estimate includes any delay buffer time at the holding point or remote de-icing prior to take off
MTTT	Minimum Turnaround Time	The minimum turnaround time agreed with an AO/GHA for a specified flight or aircraft type
SIBT	Schedule In-Block Time	The time that an aircraft is scheduled to arrive at its first parking position.
SOBT	Schedule Off-Block Time	The time that an aircraft is scheduled to depart from its parking position; associated with airport slot allocated

Acronyms	Definition	Explanation
		NOTE – this is typically referred to as Scheduled Time of Departure (STD) by the Aircraft and Airport Operators.
TOBT	Target Off-Block Time	The time that an Aircraft Operator or Ground Handling Agent estimates that an aircraft will be ready, all doors closed, boarding bridge removed, push back vehicle available and ready to start up / push back immediately upon reception of clearance from the control tower.
TSAT	Target Start-up Approval Time	The time provided by ATC taking into account TOBT, CTOT and/or the traffic situation that an aircraft can expect start-up / push back approval
TLDT	Target Landing Time	Targeted Time from the Arrival management process at the threshold, taking runway sequence and constraints into account. It is not a constraint but a progressively refined planning time used to coordinate between arrival and departure management processes. Each TLDT on one runway is separated from other TLDT or TTOT to represent vortex and/ or SID separation between aircraft
TTOT	Target Take-Off Time	The Target Take Off Time taking into account the TOBT/TSAT plus the EXOT. Each TTOT on one runway is separated from other TTOT or TLDT to represent vortex and/ or SID separation between aircraft

3.2 Roles and Responsibilities of A-CDM stakeholders

3.2.1 This section outlines the general responsibilities of the A-CDM stakeholders as part of the A-CDM process and procedures. It is recommended that any implementer tries to adopt this approach as far as practically feasible. However, it is recognised that local airport rules etc. might prohibit this.

3.2.2 The **Aircraft Operator** is generally responsible for:

- Providing the Flight Plan and any subsequent updates, i.e. DLA/CHG messages.
- Managing and providing TOBT either themselves or through their authorised GHA.
- Ensuring the flight crew is aware of the channels where TOBT and TSAT information can be obtained, as it is dependent on local procedures.
- Ensuring that their flight crew are aware of start-up and push-back procedures.
- Any change in registration or type of aircraft of ARR/DEP flights, the same should be provided to A-CDM system either directly or through a connected system (like AODB, CHG/FPL message)

3.2.3 The **Ground Handling Agent**, when authorised by aircraft operator, is responsible for providing information as mentioned in the responsibilities listed above for the Aircraft Operator

3.2.4 The **Airport Operator** is generally responsible for:

- Providing flight schedule information and any changes therein;
- Providing aircraft parking stand and gate planning/allocation and any changes therein; and
- Overall coordination of the A-CDM process during implementation and operations, including monitoring of performance of A-CDM operations.

3.2.5 The **Air Navigation Service Provider Control Tower (ANSP/TWR)** is generally responsible for:

- Providing runway-in-use and planned runway-in-use;
- Providing expected runway capacity, and minimum arrival/departure separation;
- Providing TSAT & TTOT
- When applicable, providing flow control restrictions, e.g. Minutes in Trail and/or Miles in Trail; and
- Ensuring that start-up is issued in accordance with TSAT

3.2.6 ELDT can be collected from different sources, such as airlines, ANSP and ATFM. In the arrival phase of the flight, ANSP is normally the source for providing the latest updates on ELDT.

3.2.7 The role of the ANSP can vary in the context of A-CDM in relation to how the pre departure sequencing is handled. There are two different scenarios as follows:

a) If pre departure sequencing capability available (e.g. a DMAN already installed in the ATC TWR): the ANSP should make arrangements to integrate pre departure sequencing tool's output with A-CDM system.
b) If pre departure sequencing capability not available: the ANSP should provide appropriate procedures and requirements to generate pre departure sequence.

3.2.8 The **Air Traffic Flow Management Unit (ATFMU),** when established, is generally responsible for:

- Balancing of Demand and Capacity;
- Receiving and if need be acting on relevant A-CDM data from airports;
- Coordination of Calculated Take Off Times (CTOTs/ATFM slots); and
- Provision of updated ATFM restrictions

3.2.9 In cases where de-icing is applied, the De-icing Operator is generally responsible for:

- Providing the de-icing status of the aircraft
- Prediction of the Estimated De-icing Times such as ECZT, EEZT

3.3 Standardization of A-CDM Procedures

3.3.1 Since the introduction of A-CDM, there have been many airports that have adopted the A-CDM philosophy. The expansion of implementations has led to some differences in procedures and processes. These differences may create problems for stakeholders. A harmonized approach can reduce workload. Although these differences do not constitute a compromise to safety, they constitute unnecessary additional layers of complexity.

3.3.2 Standardisation of certain A-CDM procedures to drive efficiency and overall performance is necessary. On the other hand, individual airport may have its unique implementation plan and should have the flexibility to layout its local processes and procedures, which are adapted to its own environment and operational need. However, there are a number of standards that could be applied globally or at a regional level (e.g. TOBT/TSAT procedures and compliance windows). The operations of stakeholders need to be standardized wherever possible, as the burden of differing processes may bring in inefficiency, confusion and costs.

3.3.3 The way in which procedures and processes are designed needs to incorporate input from A-CDM stakeholders. This should be a collaborative approach, which ultimately all stakeholders agree to.

3.3.4 Non-compliance of procedures should be discussed by the steering group, to remove the difficulties faced by the A-CDM Stakeholders.

3.3.5 States are encouraged to look for ways to standardize procedures and compliance windows, particularly concerning TOBT/TSAT in order to guarantee harmonization.

3.4 Target Off Block Time (TOBT) and Target Start-up Approval Times (TSAT)

3.4.1 The Target Off Block Time (TOBT) and Target Start-up Approval Time (TSAT) are critical to the A-CDM process. Based on an accurate prediction of aircraft readiness for departure, the TOBT, from Aircraft Operator, or appointed designated Ground Handling Agents, ATC can plan the optimal pre-departure sequence and TSAT at which aircraft are dispatched from the parking stands. This dynamic mechanism between the prediction of when all ground handling activities will end, i.e. at the defined TOBT and the allocation of TSAT, **are the core pillars of A-CDM**. This is also what it referred to as ***"Best planned, best served"*** principles.

3.4.2 TOBT is defined as "The time that an Aircraft Operator or Ground Handling Agent estimates that an aircraft will be ready, all doors closed, boarding bridge removed, push back vehicle available and ready to start up / push back immediately upon reception of clearance from the control tower."

3.4.3 TOBT can be predicted by tracking the flight events, so-called Milestones, that occur prior to landing and during the turnaround process. In order to achieve TOBT accuracy, close coordination of turnaround activities and sharing of operational information among different stakeholders is needed.

3.4.4 TOBT is the most important timing of the turnaround process and this timing is essential for the calculation of TSAT.

3.4.5 The TOBT should be confirmed/input at least "X1" minutes prior to the SOBT/EOBT and available for all stakeholders [X1 is preferably 30-40].

3.4.6 TSAT is defined as "the time provided by ATC taking into account TOBT, CTOT and/or the traffic situation that an aircraft can expect start-up / push back approval". In order to determine the TSAT an A-CDM implementation should consist of departure management capability (including VTT), such as Pre-Departure Sequencer or Departure Manager

3.4.7 The TSAT should be published at least "X2" minutes prior to the TOBT and available for all stakeholders [X2 is preferably 30-40].

3.5 Sharing of TOBT and TSAT

3.5.1 Sharing of the TOBT and TSAT information to flight crew is fundamental for a successful A-CDM implementation. Dependent on the local procedures and total system solution this information sharing may be done in multiple ways. How it is done needs to be agreed with the stakeholders. Examples of how to share the TOBT and TSAT to the flight crew are:

- VDGS / A-VDGS (preferred)
- Mobile application available to flight crew
- Airport Operator or Ground Handler designated role communicates TOBT and TSAT directly to flight crew.
- Aircraft Operator or Ground Handler communicates the TOBT and TSAT.
- ATC communicate the TSAT when pilot reports ready for start-up and push-back (only applicable when Pilot reports to ATC ready at TOBT)
- Open API's giving stakeholders flexibility in developing suitable solutions

3.6 A-CDM Start-up Procedures

3.6.1 Currently, airports that have fully adopted A-CDM processes, exhibit differences in their requirements for when pilots should be ready for start and push back, and report ready for start and pushback. These differences may cause confusion, in particular to pilots who operate through several airports.

3.6.2 The operating procedure related to Start-up and Push-back in the A-CDM process must clearly define the requirement of the time at which pilot should initiate call for start-up.

3.6.3 Irrespective of the TSAT, the aircraft should report/be ready for start-up/push-back at

TOBT +/- “X3” minutes [**X3 is preferably 5**].

3.6.4 Pilots should request start/pushback clearance at the TSAT +/- “X4” minutes [**X4 is preferably 5**].

3.6.5 ATC will approve start/push-back or advise the pilots of the current/updated TSAT.

3.6.6 Any time the TOBT or TSAT cannot be met, or an earlier departure is required, the TOBT should be updated expeditiously by Aircraft Operator or/Ground Handling Agent.

3.6.7 Departure clearance should be requested via Data Link Departure Clearance (DCL) at TOBT/TSAT +/- X5 minutes (X5 is defined by the local airport authority). If DCL is not available, departure clearance should be requested via RTF/Clearance Delivery at TOBT/TSAT +/- X5 minutes.

3.7 Milestone Approach

3.7.1 The Milestone approach is defined to:

a) Start and end the A-CDM process for any flight that is defined to be part of the A-CDM process and;
b) Update information about the flight at certain points during the inbound, turnaround or outbound phase.

3.7.2 In the A-CDM Process, 16 milestones are defined as per the EUROCONTROL Manual. It is important to note that not all 16 have to be used for a successful A-CDM implementation at an airport but some are required and some are optional. Ultimately, which milestones are used is dependent on the local A-CDM rules, procedures and data availability.

3.7.3 The Figure 3-1 depicts all the 16 milestones and when they occur in relation to the flight phases, i.e. inbound, turn around and outbound. Please note that the figure does not show how the milestones occur in relation to time. Another important note is that Milestone 1 and 2 is related to the outbound flight from the A-CDM airport and not related to the inbound flight coming to the A-CDM airport.

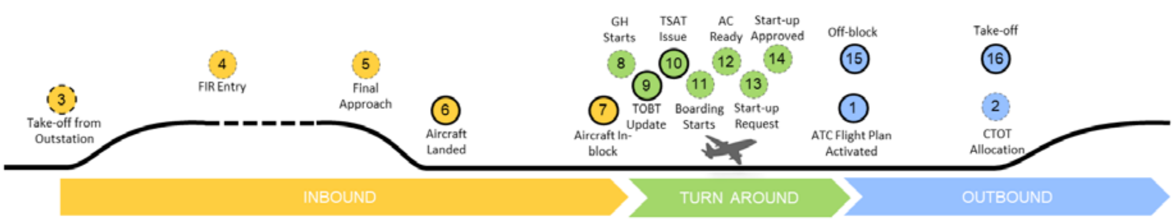

Figure 3-1: 16 Milestones of A-CDM in relation to Flight Phases

3.7.4 The Table 3-2 provides a comprehensive overview of the milestones including:

- What the purpose of the milestone is;
- How the Milestone is triggered;

- What data needs to be provided;
- A-CDM Actions;
- Example of system(s) that can provide the data; and
- Whether the Milestone is required or optional.

Table 3-2: Proposed A-CDM Milestones (MS) for the SAM Region

Milestone	Purpose of the Milestone	Milestone is triggered by	Data Elements	A-CDM Actions	Example of system(s) that typically has this data (and should share it)	Required/ Optional
MS1 **ATC Flight Plan Activated**	• Starts the A-CDM process for a flight • To check the data consistency between Airport Slot and Airline's flight plan data (EOBT vs SOBT, aircraft registration and aircraft type)	• ATC flight plan is submitted by Aircraft Operator (this happens typically at EOBT-3hrs but can also be later)	• Schedule Time of departure and arrival for the flight (STD/SOBT and ETA/SIBT) • Flight Plan EOBT • Gate/Stand	• Calculate: ELDT, EIBT, TOBT, TSAT, TTOT • Present/Disseminate : ELDT, EIBT, EOBT, SOBT, TOBT, TSAT, TTOT	• TWR Flight Data Processing System • ACC Flight Data Processing System • AODB/RMS	• Required
MS2 **CTOT Allocat3-2ion**	• To allow early awareness of departure delay if there are en-route/destination airport constraints	• CTOT issued by relevant cross-border ATFM nodes	• CTOT	• Calculate: TSAT BASED on CTOT • Present/Disseminate : ELDT, EIBT, EOBT, SOBT, TOBT, TSAT, CTOT	• ATFM System or similar capability	• Required for a fully integrated A-CDM – ATFM solution but not for a local A-CDM implementation
MS3 **Take-off from Outstation**	• To provide an ELDT at early stage by using FPL EET + ATOT. • To revise system generated TOBT, TSAT and TTOT if required • Allow early awareness of deviation from scheduled in-block time for resource	• Take-off from up-station	• ELDT	• Re-calculate: EIBT, TOBT, TSAT, TTOT • Present/Disseminate : ELDT, EIBT, EOBT, SOBT, TOBT, TSAT, TTOT	• ACC Flight Data Processing System • ACARS	• Optional

Milestone	Purpose of the Milestone	Milestone is triggered by	Data Elements	A-CDM Actions	Example of system(s) that typically has this data (and should share it)	Required/ Optional
	planning.					
MS4 **FIR Entry**	• To estimate ELDT and prompt alert if potential gate conflict is anticipated. • To revise system generated TOBT • Allow early awareness of deviation from scheduled in-block time for resource planning.	• Aircraft crosses a defined fix on FIR boundary or enters the FIR.	• ELDT	• Re-calculate: EIBT, TOBT, TSAT, TTOT • Present/Disseminate : ELDT, EIBT, EOBT, SOBT, TOBT, TSAT,	• ACC Flight Data Processing System • Extended AMAN • ACARS	• Optional
MS5 **Final Approach**	• To provide a highly accurate and stable ELDT/TLDT as landing sequence is confirmed • To revise system generated TOBT • Allow for awareness of deviation from scheduled in-block time for resource planning.	• Aircraft enters the TMA	• TLDT or ELDT	• Re-calculate: EIBT, TOBT, TSAT, TTOT • Present/Disseminate : TLDT/ELDT, EIBT, EOBT, SOBT, TOBT, TSAT, TTOT	• ACC Flight Data Processing System • AMAN • ACARS	• Optional
MS6 **Aircraft Landed**	• To revise system generated TOBT • Allow for awareness of deviation from scheduled in-block time for resource planning.	• Aircraft touches down on runway	• Actual Landing Time (ALDT)	• Re-calculate: EIBT, TOBT, TSAT, TTOT • Present/Disseminate : ALDT, EIBT, EOBT, SOBT, TOBT, TSAT,	• ACC Flight Data Processing System • AMAN • ACARS	• Required

Milestone	Purpose of the Milestone	Milestone is triggered by	Data Elements	A-CDM Actions	Example of system(s) that typically has this data (and should share it)	Required/ Optional
				TTOT		
MS7 Aircraft In-Blocks	• To revise system generated TOBT	• Aircraft arriving at the parking stand	• Actual In-Block Time (AIBT)	• Re-calculate: TOBT, TSAT, TTOT • Present/Disseminate: ALDT, AIBT, EOBT, SOBT, TOBT, TSAT, TTOT	• A-SMGCS • Docking System • ACARS • AODB	• Required
MS8 Ground Handling Starts	• To revise system generated TOBT Note: Depending on local environment, ground handling will start once aircraft in-block, i.e. MS8 and MS7 occurs at the same time	• Actual start of turnaround activities	• AGHT Note: Depending on local environment, ground handling will start once aircraft in-block, i.e. AGHT = AIBT	• Re-calculate: TOBT, TSAT, TTOT • Present/Disseminate: ALDT, AIBT, EOBT, SOBT, TOBT, TSAT, TTOT	• Same as MS7	• Optional
MS9 TOBT Update prior to TSAT issue	• Confirm and take control of TOBT • To check the feasibility of TOBT vs SOBT/EOBT.	• TOBT confirmation/update into A-CDM portal from EOBT-“X1” minutes Note: “X1” is need to be determined locally to fit the operations at the airport. Recommended to be 30 to 40 minutes.	• TOBT	• Re-calculate: TSAT, TTOT • Present/Disseminate: ALDT, AIBT, EOBT, SOBT, TOBT, TSAT, TTOT	Manual input via: • A-CDM Portal • Mobile Apps • Airline/GHA systems	• Required
MS10 TSAT Issue	• To allow decision making based TOBT and TSAT values • Create a stable pre-	• At TOBT – “X2” minutes, TSAT will be published Note: “X2” is need to be	• TSAT	• Re-calculate: TTOT • Present/Disseminate: ALDT, AIBT, EOBT, SOBT,	• A-CDM/PDS	• Required

Milestone	Purpose of the Milestone	Milestone is triggered by	Data Elements	A-CDM Actions	Example of system(s) that typically has this data (and should share it)	Required/ Optional
	departure sequence	determined locally to fit the operations at the airport. Recommended to be 30 to 40 minutes.		TOBT, TSAT, TTOT		
MS11 Boarding Starts	• To check if boarding has started as expected.	• Actual start for Boarding of passengers	• ASBT	• Re-calculate: - • Present/Disseminate : ALDT, AIBT, EOBT, SOBT, TOBT, TSAT, TTOT	• AODB/RMS • Manual input in A-CDM Portal	• Optional
MS12 Aircraft Ready	• Post analysis to measure aircraft readiness against the TOBT • Automate removal of TOBT and TSAT based if rules are not followed based on local procedures	• The call from the pilot to ATC to report ready within "X3" minutes of TOBT Note: The value of "X3" is based on local procedures. "X3" is highly recommended to be +/5 minutes	• Actual Ready Time (ARDT)	• Re-calculate: - • Present/Disseminate : ALDT, AIBT, EOBT, SOBT, TOBT, ARDT, TSAT, TTOT	Manual input in • Electronic Flight Strip System • A-CDM portal/HMI	• Optional
MS13 Start Up Request	• To measure pilot's adherence to TSAT. • Automate removal of TOBT and TSAT based if rules are not followed based on local procedures	• The call from the pilot to ATC to request pushback/start-up clearance within "X4" minutes of TSAT. Note: The value of "X4" is based on local procedures. "X4" is highly recommended to be +/5 minutes	• Actual Start-up Request Time (ASRT)	• Re-calculate: - • Present/Disseminate : ALDT, AIBT, EOBT, SOBT, TOBT, ARDT, ASRT, TSAT, TTOT	Manual input in • Electronic Flight Strip System • A-CDM portal/HMI	• Optional
MS14 Start Up Approved	• To measure ATC's adherence to TSAT • Automate removal of TOBT and TSAT based if rules are not	• The call from ATC to pilot to give clearance for push and start clearance within "X5" minutes of TSAT.	• Actual Start-up Approve Time (ASAT)	• Re-calculate: - • Present/Disseminate : ALDT, AIBT, EOBT, SOBT, TOBT, ARDT, ,	Manual input in • Electronic Flight Strip System • A-CDM portal/HMI	• Optional

Milestone	Purpose of the Milestone	Milestone is triggered by	Data Elements	A-CDM Actions	Example of system(s) that typically has this data (and should share it)	Required/ Optional
	followed based on local procedures	Note: The value of “X5” is based on local procedures. “X5” is highly recommended to be +/5 minutes		ASRT, TSAT, ASAT, TTOT		
MS15 **Off Block**	• To check if the aircraft has gone off blocks as per TSAT • Update Target Take-Off Time (TTOT) generated by DMAN/PDS if required	• Aircraft commence pushback	• Actual Off Block Time (AOBT)	• Re-calculate: TTOT • Present/Disseminate : ALDT, AIBT, EOBT, SOBT, AOBT, TTOT	• A-SMGCS • Docking System • ACARS • Manual input	• Required
MS16 **Take Off**	• End of A-CDM process and relevant stakeholders are updated with the take-off information. • Flight is removed from the A-CDM process	• Aircraft lift-off the runway	• Actual Take-Off Time (ATOT)	• Re-calculate: - • Present/Disseminate : ALDT, AIBT, EOBT, SOBT, AOBT, ATOT	• A-SMGCS • ACARS	• Required

984

3.8 A-CDM Performance Indicators

3.8.1 In order to measure the performance of A-CDM, the post-implementation performance needs to be compared against the same performance indicators that were utilised before implementation.

3.8.2 Measurement of A-CDM performance is an iterative process and the feedback mechanism is an integral part of it.

3.8.3 Measurement of A-CDM performance can be better realized based on commonly agreed indicators.

3.8.4 Table 3-3 below provides examples of A-CDM performance indicators for reference.

Table 3-3 – Examples of A-CDM Performance Indicators

Strategic Performance Indicator	Performance Driver	Performance Indicator	Performance Measurement	Milestone Measurement	Stakeholders
1) Improve punctuality and reduce delays	Turnaround punctuality	Turnaround compliance	➢ (ARDT - AIBT) - MTTT > or = 5 minutes (%) ➢ (ARDT - AIBT) - (SOBT – SIBT) > or = 5 minutes (%) ➢ AOBT – ARDT > or = 5 minutes (%)		Aircraft Operator Airport
	Arrival punctuality	In Block Time accuracy	➢ ALDT – ELDT (minutes) ➢ ALDT - ELDT > or = 5 minutes (%) ➢ AIBT - SIBT > or = 15 minutes (%) ➢ AIBT – EIBT (minutes) ➢ AXIT – EXIT (minutes) ➢ # of missed approaches, go arounds per day per RWY (Include explicit times for the missed approaches for each runway)	@ Milestones 3, 4 and 5 @ Milestones 3, 4 and 5 @ Milestones 3, 4, 5 and 6 @ Milestones 3, 4, 5 and 6	Aircraft Operator Airport

Strategic Performance Indicator	Performance Driver	Performance Indicator	Performance Measurement	Milestone Measurement	Stakeholders
	Departure punctuality	➢ Off Block accuracy (lag) ➢ Reduce departure delays	➢ AOBT - SOBT > or = 15 minutes (%) ➢ ATOT - TTOT > or = 5 minutes (%) ➢ Measure delay @ AOBT-SOBT (minutes) ➢ AXOT - EXOT (minutes)	@ Milestones 4,5,6,7,9,10,12, 13,14,15 @ Milestones 4,5,6,7,9,10,12, 13,14,15	Aircraft Operator Airport ATFM
	Reduce taxi out delay in minutes	➢ Average taxi out time in minutes across a 12 month period ➢ Taxi-out time against benefit baseline (lead) ➢ Taxi-out time accuracy (lag)	➢ Taxi-out delay (minutes) to benefit baseline (minutes and fuel) ➢ Average (ATOT – AOBT) – benefit baseline (minutes) ➢ Taxi Out Time delay converted to fuel consumption on a flight by flight basis based on # engines and engine type	@ Milestone 15	ATC Aircraft Operator Airport
2) Optimise Airport Infrastructure	Improvement in the gate/bay/stand Utilisation % Time	Overall gate/bay/stand actual occupation time	➢ Compare the overall actual gate/bay/stand occupation time with scheduled gate/bay/stand occupation time (minutes deviation) per flight ➢ Measure ARDT - AIBT per gate/bay/stand per flight by aircraft type	N/A	Airport Aircraft Operators
	Improvement in the gate/bay/stand Utilisation % Usage	➢ Gate/bay/stand usage ➢ Assess gate/bay/stand delay (lag)	➢ Measure # of turns (rotations) on each gate/bay/stand per day by Aircraft type ➢ AOBT - SOBT (minutes) ➢ AOBT - SOBT > or = 15 minutes (%) ➢ Average TSAT – TOBT > or = 15 minutes (%)	@ Milestones 9, 10, 12, 13, 14, 15	Airports
3) Gate /Bay / Stand	Reduce the number of late gate/bay/stand	➢ Gate/bay/stand allocation and passenger	➢ # of late gate/bay/stand changes within		Airports

Strategic Performance Indicator	Performance Driver	Performance Indicator	Performance Measurement	Milestone Measurement	Stakeholders
Management	changes (e.g. 10 minutes before ALDT)	gate/bay/stand freezing time (lag) ➢ Gate/bay/stand allocation accuracy (lag) ➢ Gate/bay/stand/bay conflicts (lag)	[(ALDT- 10 min) to ALDT] ➢ Number of gate/bay/stand changes after landing [ALDT to AIBT] ➢ # of bay conflicts per day	@ Milestones 4, 5, 6, 7	
4) Strategic Slot Management	Increase the # of flights that meet strategic slot compliance	Airport strategic slot adherence	➢ AIBT - SIBT -/+ 30 minutes (%) ➢ AOBT- SOBT -/+ 30 minutes (%)	N/A	Aircraft Operators Airports
5) Reduce emissions	Reduce emission from engines on ground	Emission from engines on ground (lead)	➢ Taxi-out delay (minutes) to benefit baseline (minutes and Co2)	N/A	ATC Aircraft Operators Airports
6) Congestion	Reduce number of aircraft moving simultaneously on the manoeuvring area	➢ Number of aircraft queueing on sequence in high demand periods	➢ Queue length (ATOT-AOBT) over a 15 min period, per hour over a 24 hour period	N/A	ATC Aircraft Operators Airports
7) ATFM Slot adherence	Increase ATFM slot adherence	Number of aircraft compliant with ATFM slot (CTOT)	➢ ATOT – CTOT	@ Miletone16	

4. Chapter 4 - Interoperability of A-CDM with other systems

4.1 Interactions between A-CDM and Other Systems

4.1.1 In the global aviation network, each airport is a node serving other aviation entities to achieve the safe, secure and efficient interoperability of ATM systems as a whole. The ASBU framework underpins and realizes such principle with a systems engineering approach to set the target implementation for sets of operational improvements, referred to as 'modules', including A-CDM, Air Traffic Flow Management (ATFM), and various enablers of ATM efficiency and effectiveness.

4.1.2 Airport collaborative decision-making is address in the ASBU framework in the Operational thread. It is composed of 4 modules and 6 elements, not to be confused with the "6 elements" of A-CDM implementation as per EUROCONTROL Guidance, with inclusion of TAM and integration in TBO.

4.1.3 A-CDM ASBU Elements as per the Sixth Edition of ICAO Global Air Navigation Plan are:

- **ACDM-B0/1** Airport CDM Information Sharing (ACIS)
- **ACDM-B0/2** Integration with ATM Network function
- **ACDM-B1/1** Airport Operations Plan (AOP)
- **ACDM-B1/2** Airport Operations Centre (APOC)
- **ACDM-B2/1** Total Airport Management (TAM)
- **ACDM-B3/1** Full integration of ACDM and TAM in TBO

4.1.4 To achieve the aims of subsequent ASBU A-CDM elements (B1 onwards), the implementation phase of B0/1-ACDM should be ideally interoperable-by-design that A-CDM is not only a local system serving an airport but also a node with adequate capabilities and features for integration with domestic air traffic flow management and interoperability with other systems of the cross-border (international) air space.

4.1.5 A network in its basic form is between two nodes, meaning that even a connection between two airports, for example a hub aiport and its main "feeder" airport, or between an airport an its national ATFM unit, needs to consider the systems and interactions needed to ensure the right communications and future interoperability. This needs to consider not only technological (IT) elements such as the type of connectors, interfaces, information exchange models, but also compatible procedures and a common vocabulary.

4.1.6 To effectively formulate and develop the implementation phase of A-CDM, the following ABSU modules and elements as well as their interactions with A-CDM should be studied in depth and incorporated gradually into an A-CDM implementation:

(a) Air Traffic Flow Management (ATFM) under B0-NOPS.

(b) Runway sequencing (RSEQ) under B0-RSEQ

(c) Surface operations (SURF) under B0-SURF

(d) Meteorology under B0-AMET

(e) System Wide Information Management (SWIM) under B2-SWIM.

(f) Flight Information Exchange Model (FIXM) under B2-SWIM.

(g) ATS Message Handling System (AMSH) under COMI-B0

4.1.7 Appendix A provides more information about the ASBU modules and elements interacting with A-CDM. Full details are available from the ICAO GANP website at https://www4.icao.int/ganpportal/

4.2 Systems View of A-CDM and Other Systems

4.2.1 In the contemporary context of ATM systems, 'system' has moved beyond the equipment for Communications, Navigation, Surveillance and ATM (CSN/ATM) and 'interoperability' has moved beyond the computerisation interfaces documented by the Interface Control Document (ICD). In the most general sense, system means a configuration of parts joined together by a web of relationships e.g. a man-made system comprising of actors and machines as well as the interoperability between equipment and procedures. The systems engineering approach can be extended, beyond the formulation of high level requirements of ASBU modules and elements, deep down for the development and implementation of the ASBU elements selected by individual aviation entities concerned including airport authorities and air navigation services providers.

4.2.2 Being holistic in flavour, efforts of systems engineering can harmonise and entail outcomes of all specialties and actors to enable a successful system which achieves users' satisfaction. To address specific operational needs of A-CDM and ATFM at a region, sector or airport, systems engineering efforts would be needed to mix and match the adoption of evolving operational concepts and the acquisition of numerous emerging technologies such as Demand and Capacity Balancing (DCB), Linked Arrival Management and Departure Management (AMAN/DMAN), Flight and Flow Information for the Collaborative Environment (FF-ICE), AIXM, FIXM, AIDX, SWIM, etc.

4.2.3 Before implementation of the selected solutions, systems engineering principles can be used to tackle domain-specific problems and evaluate trade-offs between innovations and risks. Harmonising with the global wheel of ASBU, systems engineering practice can be followed to orchestrate the complete development of various CNS/ATM systems by applying a set of life-cycle building blocks and aligning technologies to meet targets of ASBU.

4.2.4 Under the systems view, A-CDM can be implemented as a specific application of CDM in the airport environment and ATFM facilities are being developed in an ecosystem with a domestic and cross-border network of many advanced, legacy and aged systems that airports are physical nodes inside virtual ATFM nodes on the network. Appendix B provides use cases for interoperability of A-CDM with other systems, especially for ATFM.

4.3 Project Framework for Integration/Interoperation of A-CDM with ATFM Systems

4.3.1 In line with the timeframe of ICAO ASBU, the outcomes from Block-0 implementations of A-CDM and ATFM could be leveraged to ensure the interoperability of equipment, procedures and practices among the pioneering aviation authorities and administrations in the South American Region. This will set the guidelines and successful templates for all aviation entities to join the roadmap.

4.3.2 A good practice for development and implementation of A-CDM initiatives should:

(a) Utilize ATFM measures e.g. CTOT from ATFM and various milestones from ACDM-B0 to collectively improve the efficiency and effectiveness of air traffic services and airport operations;

(b) Consider the procedures in place in order to integrate to those.

(c) Consider current ATFM communication capabilities and incorporate those to A-CDM implementations so that A-CDM is capable of obtaining information from ATFM and on the other hand sending information to ATFM. AMHS interfaces must be consider initially (as is the current communication scheme of most ATFM units and ATC centers) with the consideration to also enable FIXM interconnections, as FIXM will, in the future, take over teletype based communications.

(d) Contribute to regional and sub-regional efforts for the standardisation of flight and flow data as well as the development of Implementation Guidelines and Interface Control Documents for subsequent Implementations;

(e) Collaborate among stakeholders on development aligning with ACDM-B0/2 module's aim for integration of A-CDM with ATFM;

(f) Leverage the solid foundation established from ACDM-B0 and NOPS-B0 modules and take A-CDM into consideration when developing ATFM techniques and algorithms for network operations in multi-nodal and/or harmonised settings;

(g) Explore the performance improvement through the application of REDDIG infrastructure and SWIM for regional FIXM information exchange models to pave the way for the acquisition of future full data-driven ATFM and A-CDM facilities;

(h) Realise the potential of AIDX initially and then FIXM for richer content exchanges, between automated systems of A-CDM airports and the A-CDM and ATFM network in the SAM region, respectively; and

(i) Establish the systems engineering plan that holistically covers conceptualisation, development, acquisition and implementation of the abovementioned initiatives and trials to bring fruitful outcomes to aviation users of the systems.

4.3.3 Beyond the document-based interoperability of equipment interfaces, regional and/or sub-regional coordination should be made to develop model-based interfaces for computerisation between A-CDM, ATFM and ATC systems, with the following steps:

(a) Make agreements between the A-CDM and ATFM communities on the choice of '**Milestones**' for developing interoperable procedures between A-CDM and ATFM.

(b) Compromise the '**Compliance**' of flights meeting both A-CDM milestones and ATFM measures.

(c) Develop and materialise Concept of Operations (CONOPS) for Interoperability between A-CDM and ATFM processes.

(d) Identify data items and the 'Timeline' of their exchanges needed to realise the CONOPS and develop the common operating procedures for processing and utilizing the data items.

(e) Research and develop model-based '**Interfaces**' to enable the automation of data processing and information utilization.

(f) Develop and implement operational trial projects to verify and validate the interoperable elements and components.

(g) Articulate the outcomes of trial to develop reference models with reusable elements and components to minimise the redesign efforts of Members.

(h) Complete formal adoption of the reference models e.g. FIXM Extension into the ICAO documents.

4.3.4 Instead of a big bang implementation, the steps suggested above should be performed in an iterative manner, via forums and working groups among experts from members of the SAM Region. The incremental approach has to bridge in-depth studies of integration/interoperation between A-CDM and ATFM as well as to foster close liaison for developing A-CDM and ATFM network operations in more collaborative manner.

5. Chapter 5 – Current situation

5.1 Overview of the Survey results

5.1.1 The survey questionnaire sent to 14 Member States of the ICAO South American Region, including French Guiana. Ten (10) SAM States / Administrations (Bolivia, Brazil, Chile, Colombia, Ecuador, Panama, Paraguay, Peru, Uruguay and Venezuela) responded to the survey.

5.1.2 No response receipt from Argentina, French Guyana, Guyana and Suriname. Of these 4 states, Argentina has airports with a high level of current traffic and growth.

5.1.3 The percentage of States / Administrations that answered the survey questionnaire is 71.4%.

5.1.4 The following table presents a summary of those airports where the implementation is under execution. The legend of the table is as follows:

- A value of “0” in the year is that the survey was answered, but no data was given or no specific date
- A “NR” value means that the survey was not answered

Member State	Airport	Year
Argentina		NR
Bolivia	Viru Viru	0
Brasil	Aeroporto Internacional De Guarulhos - SP	2020
	Aeroporto Internacional Tancredo Neves (Confins) - BH	2022
	Aeroporto Internacional Tom Jobim (Galeão) – RJ	2023
	Aeroporto Internacional de Brasília -DF	2024
Chile	Aeropuerto Arturo Merino Benítez - Santiago	2020
Colombia	Aeropuerto Internacional El Dorado	2020
Ecuador		0
Guyana Francesa		NR
Guyana		NR
Panamá	Aeropuerto Internacional de Tocumen	2015
Paraguay	Silvio Pettirossi SGAS	2025
Perú	Lima	2021
	Cusco	2021
Suriname		NR
Uruguay	Carrasco	2021
	Laguna del Sauce	2021
Venezuela		0

5.2 Survey conclusions

5.2.1 Despite several scenarios with capacity problems in the region, the results indicate that the implementation of A-CDM is moving at a relatively low rate or the report by the States may not be representing what the airport operators are doing on their own. Some States have even placed implementations in very short times and at aerodromes with low traffic / complexity levels, which could be an indication of an underestimation of the complexity and time really needed to implement

A-CDM.

5.2.2 The lack of commitment indicated as one of the main challenges in the implementation. This assumes that there is not, at the regional or local level, information or analysis on the contribution of A-CDM to capacity shortages to support the effort in carrying out the implementation. It is important to highlight that A-CDM is not a requirement, much less, its implementation is mandatory, it is rather a form of collaborative work that seeks, through effective and timely communication, to reduce uncertainty and allow better management, which then results in all the benefits already indicated.

5.2.3 As in other regions, the survey results identify that some areas of attention are:

- **Relationship between the A-CDM conceptual elements and milestones**. These are discrepancies in the responses indicating that the implementation of milestones and their purpose might not be fully understood.

- **How to measure the success of an A-CDM implementation.** All respondents indicated very clear objectives related to implementation A-CDM but at the same time not all have established how to measure that these objectives are achieved

- **Getting all stakeholders engaged as well as managing an A-CDM project**.

6. Chapter 6 – Performance Improvement Plan

To be completed.

*****UNDER DEVELOPMENT***** **Table 6-1 – A-CDM related performance expectations mapped to relevan CARSAM Regional Air Navigation Plan expectations**				
GANP	**CARSAM e-ANP**		**SAM A-CDM Implementation Plan (proposed)**	
ASBU	Performance Expectation	Timeframe	Performance Expectation ***Note: Performance expectations are to be proposed and analyzed by States and Industry via an A-CDM task force or similar expert group. The following is a proposal, based on the APAC experience*	Timeframe
ACDM-B0/1: Airport CDM Information Sharing (ACIS) Description: This element represents the first collaboration step among stakeholders involved in aerodrome operations. It consists in the definition of common specific milestones for flight events occurring during surface operations. The stakeholders involved have to, based on accurate operational data, achieve the agreed milestones. Maturity level: Ready for implementation.	To be determined (Vol. III e-ANP)	To be determined (Vol. III e-ANP)	1. PROPOSAL: Local A-CDM procedures, supported by systems supporting the exchange of TOBT and TSAT between aircraft operators and the ATC Control Tower, should be implemented	**Phase 1 – Local A-CDM**
			2. PROPOSAL: All A-CDM Airports should establish variable taxi-times for all combinations of gate or apron and runway holding points	
			3. PROPOSAL: Where implemented, pre-departure sequencing procedures and systems should be integrated with A-CDM.	
ACDM-B0/2: Integration with ATM Network Function Description: This element consists in feeding arrival information from the network into A-CDM and at the same time to coordinate specific departure milestones. The involved stakeholders have to, based on accurate operational data, achieve the agreed milestones. Maturity level: Ready for implementation	To be determined		1. PROPOSAL: A-CDM and ATFM system should be integrated by: a) ATFM systems taking TOBT and/or TTOT into account when determining CTOT (if applicable); and b) A-CDM systems taking CTOT into account when determining TSAT;	

*****UNDER DEVELOPMENT***** **Table 6-1 – A-CDM related performance expectations mapped to relevan CARSAM Regional Air Navigation Plan expectations**				
GANP	**CARSAM e-ANP**		**SAM A-CDM Implementation Plan (proposed)**	
ASBU	Performance Expectation	Timeframe	Performance Expectation ***Note: Performance expectations are to be proposed and analyzed by States and Industry via an A-CDM task force or similar expert group. The following is a proposal, based on the APAC experience*	Timeframe
<u>ACDM-B1/1</u>: Airport Operations Plan (AOP) <u>Description</u>: This element consists of a collaborative airport operations plan (AOP) which encompasses “local” airport information and shared information with the ATM network in order to develop a synchronized view for the integration of local airport operations as well as aircraft operations into the overall ATM network. The AOP includes an airport performance framework and steers with specific performance indicators and targets aligned with the regional/national performance frameworks, building upon A-CDM. Information on resources and aircraft operation plans is available to the different operational units on the airport and elsewhere in ATM. The AOP may be managed and monitored by the Airport Operations Centre (APOC). <u>Maturity level:</u> Standarization	To be determined		To be determined	
<u>ACDM-B1/2</u>: Airport Operations Centre (APOC) <u>Description</u>:	To be determined		To be determined	

*****UNDER DEVELOPMENT***** **Table 6-1 – A-CDM related performance expectations mapped to relevan CARSAM Regional Air Navigation Plan expectations**				
GANP	**CARSAM e-ANP**		**SAM A-CDM Implementation Plan (proposed)**	
ASBU	Performance Expectation	Timeframe	Performance Expectation ***Note: Performance expectations are to be proposed and analyzed by States and Industry via an A-CDM task force or similar expert group. The following is a proposal, based on the APAC experience*	Timeframe
The APOC will bring stakeholders together in a physical entity (team) enabling them to better communicate and coordinate, to develop and dynamically maintain joint plans which are executed in their respective areas of responsibility at the airport. Its main information source is the Airport Operations Plan, which integrates information from the appropriate process monitors, collating it into consistent, timely and reliable knowledge for the airport's various operational units, in particular the APOC. The APOC will be equipped with a real-time monitoring system, a decision support system and will apply a set of collaborative procedures that build upon the capabilities of the AOP. This will ensure that the management of landside and airside airport processes will be fully integrated. <u>Maturity level:</u> Standarization				
<u>**ACDM-B2/1**</u>: Total Airport Management (TAM) <u>Maturity level:</u> Validation	To be determined		To be determined	

*****UNDER DEVELOPMENT***** **Table 6-1 – A-CDM related performance expectations mapped to relevan CARSAM Regional Air Navigation Plan expectations**				
GANP	**CARSAM e-ANP**		**SAM A-CDM Implementation Plan (proposed)**	
ASBU	Performance Expectation	Timeframe	Performance Expectation ***Note: Performance expectations are to be proposed and analyzed by States and Industry via an A-CDM task force or similar expert group. The following is a proposal, based on the APAC experience*	Timeframe
ACDM-B3/1: Full Integration of ACDM and TAM y TBO Maturity level: Concept	To be determined		To be determined	

7. Chapter 7 - Research and future development

7.1 The Evolution of A-CDM

7.1.1 A-CDM has its roots in Europe and is the foundation for many European SESAR concepts for use of better data and technology to make aircraft and airport operations more efficient. Wider potential for success lies in integrating the networks. Connectivity and data sharing amongst a constellation of A-CDM airports will ultimately deliver optimal performance. The wider benefits of A-CDM should be considered in addition to local enhancements.

7.1.2 The evolution of A-CDM, and the manner in which the implementation process is introduced throughout the world, should be given due consideration. The most replicated model of A-CDM is the European version, interfacing with EUROCONTROL. However, not all regions have such a centric ATM network, so the processes may be different in other regions. To assist in making the implementation of A-CDM more successful, it is recommended that a regional ATFM environment be established e.g. via a distributed multi-nodal ATFM network, which would enable a certain degree of harmonization and provide consistency for stakeholders.

7.1.3 It is important to bear in mind that according to ICAO Document 9971, while ATFM is not a prerequisite to the realization of A-CDM, it is evident that any form of ATFM (or network operations/management) will benefit from being connected to A-CDM.

7.1.4 In addition, many important high density airports (hubs) may benefit if they are integrated and receive predictive information from their feeder airports. These “feeder” airports may be interested also to explore the possibility to integrate into a network pre-ACDM, without implementing it or as an initial step towards a future A-CDM implementation.

7.1.5 In response to this, Appendix E includes a proposal for the integration of those airports that have no plans to implement A-CDM, but still wish to exchange data with hub airports. It is important to mention that this is still a concept and needs to seek maturity and validation thru its review by States and Industry.

7.1.6 One of the most important aspects of A-CDM from a global perspective is the architecture that interfaces airports with other airports and airspace management system. A model for exchange of information between A-CDM and ATFM should be kept in mind during A-CDM implementations.

7.1.7 The industry is seeing other facets of airspace management using A-CDM concepts to provide the required data to fulfil continuity between major traffic flows, and high density aerodromes. This will create other hybrid type A-CDM processes, that are best suited for regional requirements. Some regional requirements like data exchange amongst different ATFM applications may require appropriate system design and adaptation, but the primary purpose remains to mitigate airborne flow constraints that contribute to overflow in ATC sector capacities, which result in unanticipated enroute delays.

7.1.8 As air traffic management evolves, and additional concepts are introduced by the industry, changes and adjustments to A-CDM may be required. This will most certainly contribute to the complexities of data exchange. However, the industry must not lose sight of harmonizing A-CDM.

7.2 A-CDM and ATFM in South American Region

Under development.

7.3 Participation of MET organizations in CDM

7.3.1 MET CDM is a process involving the development within aeronautical meteorological services of an understanding of the effects of weather on ATM to support an accurate prediction of arrival/departure rates and en-route airspace capacity and configuration. The expected role of a MET organization in CDM is to provide necessary meteorological information at and around relevant aerodromes and air routes, and within relevant airspace, in a timely manner. Rapid identification of the possible cause of adverse weather condition affecting ATM operations, and airport or airspace capacity, allows both ATM and MET organizations to take immediate action in a collaborative manner to mitigate the impact.

7.3.2 Future development of A-CDM should include development of the capability for MET organizations to actively participate in A-CDM processes, including the collaborative information exchange processes to support timely and relevant MET information supporting A-CDM.

8. Chapter 8 - Training

8.1 Who

8.1.1 All partners who are active both within the implementation project and whose work directly involves Airport CDM should receive in depth training. This is because it involves a new way of working with, quite possibly, new procedures and processes.

8.1.2 Specifically operational staff of ANSPs, airports, airlines and ground handlers should be trained. It may also be of interest to anyone from other organisations involved in the implementation of ACDM activities.

8.1.3 It is an idea to provide some level of training to the IT and implementing team so they can fully understand the concept prior to the start of the project.

8.2 What

8.2.1 The course should cover the concept elements and how to apply the various techniques of A-CDM in relation to the different partners operations.

8.2.2 The dedicated modules sould focus on the role, tasks and responsibilities of each CDM partner.

8.2.3 It should highlight the information sharing module showing how effectively shared information can benefit operational decisions of the various partners.

8.3 When

8.3.1 The training phases should be scheduled within the project plan. Awareness programs should be started in the early stages of implementation but it is advisable to plan the main training sessions near to the project completion, this to avoid the need for refresher training if training is conducted too early.

8.4 How

8.4.1 Instructors should be fully trained on the Airport CDM concept. Various methods for training can be utilized, however it is important that all relevant personnel are fully trained.

8.4.2 It is advisable that other staff receive at least an awareness program to increase an promote the A-CDM.

8.4.3 Courses should be organised, preferably in a mixed partner environment to have staff from several operational airport partners in one room, discussing new procedures and viewing the problems that occur during the many activities in the turn-round of an aircraft and solutions offered by Airport CDM

8.4.4 Self-teach or internet based training can also be considered but this should not be considered as the only training required. If it is developed then the training material is probably best developed as an interactive, with specific modules for each partner. This approach can save expensive training time and be considered as refresher training.

8.5 Continuance

8.5.1 Recurrent and refresher training sessions should be planned as standard, whether to cover enhancements within the A CDM processes, for new staff or ones who have changed roles.

APPENDICES

Appendix A – Relationships between A-CDM and ASBU Modules

Introduction

1. This appendix supplements and references information regarding the 6th Edition of the Global Air Navigation Plan (GANP) available at https://www4.icao.int/ganpportal/

A-CDM in the Global Aviation Network

2. In the global aviation network, each airport is a node serving other aviation entities to achieve the safe, secure and efficient interoperability of Air Traffic Management (ATM) systems as a whole. The ASBU framework underpins and realizes such principle with a systems engineering approach to set the target implementation time frames for sets of operational improvements, referred to as 'modules', including Airport Collaborative Decision Making (A-CDM), Air Traffic Flow Management (ATFM), and various enablers of ATM efficiency and effectiveness.

3. The ASBU elements were defined in previous versions of the GANP in an inconsistent manner. An ASBU element is a specific change in operations designed to improve the performance of the air navigation system under specified operational conditions.

4. The ASBU enablers are a new concept in the updated ASBU framework (GANP 6th Edition, 2019). They are the components (standards, procedures, training, technology, etc) required to implement an element. Some of the enablers can be elements in other threads, for instance: avionics or ground systems in the technology threads.

5. The ASBU threads already existed in previous versions of the GANP and they were key feature areas of the air navigation system where improvements are needed in order to achieve the vision outlined in the Global ATM Operational Concept.

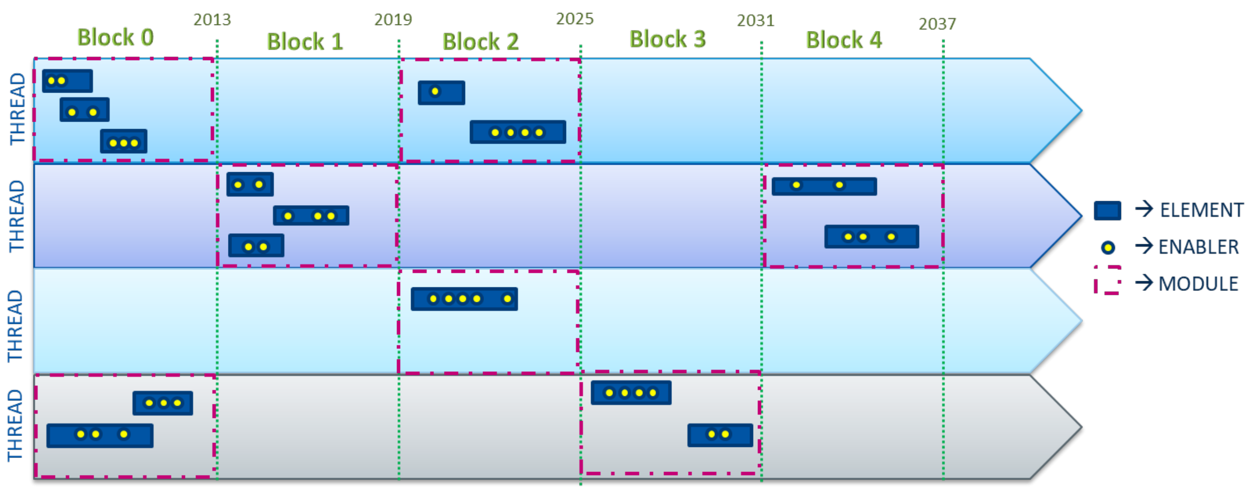

Figure A-1: Aviation System Block Upgrades (ASBU) Framework

6. The ASBU threads are been categorized in 3 groups: Operational threads (ACDM, APTA, NOPS…), Information threads (SWIM, AMET, DAIM, FICE,…) and Technology threads (COMS, COMI, NAVS, ASUR)

7. The ASBU modules already existed in previous versions of the GANP and they are the crossing point between the threads and the blocks. Therefore, an ASBU module is the group of elements from a thread that, according to the enablers' roadmap, will be available for implementation within the defined deadline established by the ASBU Block.

8. An ASBU Block is the end date of a six years timeframe that defines a deadline for an element to be available for implementation. This implies, that the element and all the enablers associated to it, need to be available for implementation by the ASBU block year.

9. Airport collaborative decision-making is addressed in the ASBU framework in the Operational thread. It is composed of 4 modules and 6 elements, with inclusion of TAM and integration in TBO. The previous version of the GANP included 2 modules

10. A-CDM ASBU Elements:

- **ACDM-B0/1** Airport CDM Information Sharing (ACIS)
- **ACDM-B0/2** Integration with ATM Network function
- **ACDM-B1/1** Airport Operations Plan (AOP)
- **ACDM-B1/2** Airport Operations Centre (APOC)
- **ACDM-B2/1** Total Airport Management (TAM)
- **ACDM-B3/1** Full integration of ACDM and TAM in TBO

11. According to the ICAO GANP portal, the Concept of Operations of A-CDM by Block is described as:

Block	**Description**
Baseline	All stakeholders involved in aerodrome operations have their own processes that are conducted as efficiently as possible. However, there is not enough effective information sharing among them. Some basic coordination between ATC and ramp control (which may also be provided by ATC) exists. The aerodromes operate in isolation from the ATM network and aircraft operators manage their operations independently from each other.
Block 0	Aerodrome operators, aircraft operators, air traffic controllers, ground handling agents, pilots and air traffic flow managers share live information that may be dynamic, in order to make better and coordinated decisions. This applies notably in day to day operations and also in case of severe weather conditions or in case of emergencies of all kinds; for these cases A-CDM procedures are referred to in the snow plan, the aerodrome emergency response plan and the aerodrome manual. In some cases, aerodromes are connected to the ATM network via the ATFM function or to ATC through data exchange.
Block 1	Aerodromes are integrated within the ATM Network, from the strategic through all tactical phases. Situational awareness and decision support information is made available to affected stakeholders to establish a common understanding of the various needs and capabilities and make adjustments to assets in order to cope with these needs. Support mechanisms include an Airport Operations Planning (AOP) and an

	Airport Operations Centre (APOC).
Block 2	Planning and management of airport operations is enhanced through Total Airport Management (TAM), meaning that passenger terminal management is fully integrated with "traditional" A-CDM in order to optimise aerodrome operations and passenger management. Tools and decision support information supporting landside management are made available and interfaced with Airport Operations Centre.
Block 3	All stakeholders are fully connected. All tactical decisions are synchronized and operations are managed by trajectory. All ground processes including aircraft turnaround operations and the landside processes are agreed on the en-route to en-route view of flight operations. Expected ground event times are managed with known impacts to the ATM system, to ensure that the agreed trajectory is consistent with the Airport Operations Plan.

A-CDM with Air Traffic Flow Management

12. According to the ICAO Standards and Recommended Practices (SARPs) Annex 11 Chapter 1: "*ATFM has the objective of ATFM contributing to a safe, orderly and expeditious flow of air traffic by ensuring the air traffic control capacity is utilized to the maximum extent possible, and that the traffic volume is compatible with the capacities declared by the appropriate Air Traffic Services authority*."

13. Building up from B0-NOPS Network Operations, ATFM is used to manage the flow of traffic in a way that minimizes delays and maximizes the use of the entire airspace. Collaborative ATFM can regulate traffic flows involving departure slots, smooth flows and manage rates of entry into airspace along traffic axes, manage arrival time at waypoints or flight information region (FIR)/sector boundaries and re-route traffic to avoid saturated areas.

14. With the improvements under B1-NOPS, ATFM can be integrated with airspace organization and management (AOM) to accommodate the use of free routings. The ATFM algorithms and techniques can be enhanced to:

(a) regulate traffic flows involving departure slots, smooth flows and
(b) manage rates of entry into airspace along traffic axes,
(c) manage arrival time at waypoints, flight information region or sector boundaries,
(d) reroute traffic to avoid saturated areas, and
(e) address system disruptions including crisis caused by human or natural phenomena.

15. According to the ICAO Manual on Collaborative Air Traffic Flow Management (Doc 9971), it is a general rule that "ATFM is needed whenever airspace users are faced with constraints on their operations, and in areas where traffic flows are significant".

16. However, as limited by the current capabilities of most ATFM facilities, the ATFM process is commonly applied to regulating traffic flows (or balancing demand of airspace users) by means of ground delay program, level capping, airspace flow program, minimum departure, miles in trial, minutes in trial, etc. Some of these ATFM measures may counteract the benefits of the A-CDM turnaround process. In the worst case, passengers are delayed inside fuselage the aircraft has been off-block to taxiway or is airborne amid 'flow control'.

17. In a nut shell, when delays of flight operations cannot be avoided, collaborative decisions must be made orderly and timely to balance the impacts on airports and airspaces for the sake of all aviation entities and stakeholders in an open and fair manner, reflecting data for the full trajectory of a flight.

18. As mentioned in Doc9971, A-CDM aims to improve the exchange of information among actors and stakeholders and therefore to improve local operations. However, it is also a key enabler in linking these operations to the ATM network.

19. While ATFM is not a prerequisite to the realization of A-CDM, it is evident that any form of ATFM (or network operations/management) will benefit from being connected to A-CDM. Operations conducted at a CDM airport will be enriched by enhanced arrival information from the ATM network. Network operations will also benefit from more accurate departure information from CDM airports

20. For countries or regions without ATFM services, A-CDM could be the enabler to connect adjacent ATC units or other airports.

<u>A-CDM with System Wide Information Management</u>

21. System Wide Information Management (SWIM) is a new way for managing and exchanging information. It replaces the current ground-ground point-to-point information exchange by an aviation intranet relying on internet technologies enabling information services to be provided to the ATM community. In order to facilitate publish/subscribe and request/reply based information exchange through standardised information services, provisions for the information service content and service overview are defined and appropriate SWIM governance established.

22. SWIM is expected to enable node-based A-CDM sharing up-to-date relevant information with other aviation entities including other airports, airlines, domestic, cross-border and regional AFTM units so that the preferences, available resources and the requirements of the stakeholders at the airport can be taken into account with a process of collaborative decision-making (CDM) by all parties concerned. The implementation of system-wide information management (SWIM) services provides the infrastructure and essential applications based on standard data models and internet-based protocols to maximize interoperability when interfacing systems for A-CDM, ATFM and other ATM functions.

23. The goal of SWIM is to realize a global network of ATM nodes, including the aircraft, providing or using information. Aircraft operators with operational control centre facilities will share information while the individual user will be able to do the same using other applications. The support provided by the ATM network will in all cases be tailored to the needs of the user concerned, e.g. A-CDM and ATFM.

24. In the South American Region, the current implementation of the *SAM Region Digital Network* (REDDIG) enables a cross-border, high-speed and secured communication network, which serves as a key enabler for implementation of a number of seamless ATM initiatives. The implementation and operation of REDDIG network is overseen by the ICAO Technical Cooperation Project RLA03/901, while several civil aviation authorities are working on the data implementation and SWIM over REDDIG.

<u>A-CDM with Cross-Exchange of Structured Information</u>

25. The ASBU module, B1-DATM Digital ATM information, addresses the need for information integration and supports a new concept of ATM information exchange fostering access via the SWIM services. This includes the cross-exchange of common elements with the initial introduction of the ATM Information Reference Model (AIRM), which integrates and consolidates ATM information in a transversal way. Key exchange models include:

(a) Flight Information Exchange Model (FIXM) for flight and flow information and aircraft performance-related data,

(b) ICAO Meteorological Information Exchange Model (IWXXM) for information related to weather, and

(c) Aeronautical Information Exchange Model (AIXM) for digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS) in accordance with the ICAO SARPs Annex 15.

26. The data interoperability between A-CDM and ATFM may be assured by the use of FIXM found on the concept of flight object and the widely adopted eXtensible Markup Language (XML). This common model of structured information for flight object will effectively enable ground-ground exchanges before departure, under the ASBU module, B1-FICE.

Appendix B – Use Cases for Interoperability of A-CDM with Other Systems

Introduction

1. This appendix provides use cases to highlight ways that A-CDM can be implemented as a local system serving an airport as well as a node with adequate interfacing capabilities for integration and interoperation with air traffic flow management (ATFM) and other systems of the cross-border net-centric airspace.

2. In the context of System Wide Information Management (SWIM), "interoperability" means the ability of information and communication technology (ICT) systems and of the business processes they support to exchange data and to enable the sharing of information and knowledge. The interoperability of A-CDM can range from close integration of specialized computer systems in-and-around an airport implementation and loose coupling of service-based automation systems in a regional net-centric airspace.

3. To achieve effective and efficient sharing of information, a user interface is needed to allow quick and easy viewing and input of information taking into consideration heavy airport and air traffic control (ATC) workload scenarios.

4. To facilitate automated interactions, a system interface is needed to demark a shared boundary across which two or more of these different systems and their software applications to communicate, exchange data, and use the information that has been exchanged.

5. The interfacing capability of an A-CDM implementation can be categorized by the following use cases and options according to their degree of integration and spectrum of interoperability.

Use Case 1 - Interfaces of Standalone A-CDM Platform

6. In an operation without A-CDM, information about key airside processes is typically sourced from multiple different systems leading to gaps and inefficiencies. With A-CDM, a common platform collates data from the airport and ATC systems and presents it to operational stakeholders in a format that helps them make more informed decisions.

7. In general, an **A-CDM web portal** can be used as a specially designed website that brings information from diverse sources in a uniform way so that stakeholders will access information about the key airside processes through the web portal. It is then incumbent on the stakeholders themselves to update their plans, resourcing decisions and working practices to make best use of the information and optimize performance accordingly.

8. The web portal essentially facilitates a common milestone process that corresponds to significant events across each of the airside processes to enable and ensure a level of consistency across the airport and its airside entities that are adopting an A-CDM information sharing function. The successful completion of each milestone triggers operational decisions for stakeholders concerned with future events in the process.

9. In addition to the web portal as user interface, an A-CDM platform may offer application programming interface (API) for other systems to automatically receive and send A-CDM information. These system interfaces may have an inter-system messaging capability based on proprietary communications protocols or various de facto engineering standards.

10. Through its system interfaces, an A-CDM platform can extract process-information about airport and flight operations. Then, the A-CDM algorithms can combine and evaluate the information collected. With both the user and system interfaces, the A-CDM will share the updated information and milestones (including pre-departure sequence and related estimated times) to optimize the flow of outbound traffic.

11. Options of interfacing automated systems for A-CDM may include:

(a) Dedicated data links may be used between the A-CDM platform and each of its partnering systems for conveying milestones and messaging on one-to-one basis.

(b) The A-CDM platform may be connected to the Aeronautical Fixed Telecommunication Network (AFTN) for sharing information with destination airports, air traffic control units, air traffic flow management units and the wider air transport network.

(c) A cloud-based solution may be used to enable economies of scale by providing a common platform to multiple airports as a single A-CDM implementation and link the A-CDM implementation to other systems with a great range of interoperability allowing access by service-oriented APIs, web service, and the like based on open standards and industry good practices.

12. The deployment of a standalone A-CDM platform can reduce the exposure of existing critical systems like the Airport Operations Database (AODB) and Flight Data Processing System (FDPS) to the risks of corruption when introducing the new A-CDM. Moreover, existing systems can continue to follow their specific roadmaps for upgrade or replacement with minimum dependencies on the evolving A-CDM functions.

13. However, the lack of network-wide interoperability cannot automatically validate information in multiple disparate systems, while manual cross-checks are required to identify and resolve discrepancies on each system concerned. With more systems interacting with a standalone A-CDM implementation, the risks of errors and delays in the net-centric CDM process will be increased.

<u>Use Case 2 - Net-centric Interfaces of A-CDM</u>

14. Under the initiatives of Aviation System Block Upgrades (ASBU), SWIM suggests the use of service-oriented architecture (SOA) to realize the concept of information-centric and net-centric air traffic management (ATM) operations. As one of the prime objectives of net-centric CDM, airport integration with ATFM Unit shares more precise and detailed information about airside processes and an optimized departure sequence by taking into account both aerodrome and airspace slots as well as other prevailing operational circumstances such as weather changes and military aviation activities.

15. Several options for network connectivity and system interoperability are available for interfacing A-CDM via ATFM into the global aviation network.

16. An A-CDM platform may connect to an ATFM Unit via a dedicated AFTN connection, but the interoperability between A-CDM and ATFM is constrained by the text-based communications characteristics of AFTN.

17. An A-CDM platform may connect to an ATFM Unit via a peer-to-peer data link that can support internet protocol based (IP-based) communications according to the interface control document (ICD) agreed between the A-CDM platform and the ATFM Unit. The ATFM Unit will act a broker or

agency to optimize the flow of air traffic in and out the airports, which participate in the A-CDM platform. The interface between A-CDM and ATFM may use communication protocols, which are different from that of the global aviation network, so the ATFM Unit has to provide data conversion as well as align interactions between network actors.

18. The Unified Modeling Language (UML), as a developmental modeling language, can be used to provide a standard way for visualizing the design of system interfaces for SWIM-enabled applications as well as showing the structure of the data to be exchanged.

19. The use of Flight Information eXchange Model (FIXM), which is a UML model, will ensure both syntactic interoperability and semantic interoperability. Other models mapped to FIXM, such as IATA AIDM, may also be considered.

20. For specifying data formats and communication protocols, eXtensible Markup Language (XML) or Structured Query Language (SQL) standards are among the tools of syntactic interoperability. These tools are also useful for lower-level data formats, such as ensuring alphabetical characters are stored in a same variation of ASCII or a Unicode format (for English or international text) in all the communicating systems including ATS Messaging System (AMHS).

21. Beyond the ability of two or more computer systems to exchange information, semantic interoperability is the ability to automatically interpret the information exchanged meaningfully and accurately in order to produce useful outcomes as defined by the end users of both systems. To achieve semantic interoperability, both A-CDM and ATFM must refer to a common information exchange model, such as FIXM. Based on unambiguously defined content in all information exchange requests, what is sent from donor/owner is the same as what is understood at the requester/receptor.

22. Other open standards are expected to be applied at all levels of the SWIM framework, which include the World Wide Web Consortium (W3C) specifications (World Wide Web Consortium (W3C), 2013), Unified Modelling Language (UML), and the standards for network layer exchange.

23. An A-CDM platform may connect to an ATFM Unit or other A-CDM platform based on the implementation specifications of SWIM which may be defined on a local, sub-regional, regional and/or global scale conforming to open standards. The A-CDM milestones, together with process information for improving the milestones and related estimated times, are exchanged via the SWIM infrastructure based on information management standards. The seamless interoperable data exchange and services will benefit the global aviation network as a whole.

Use Case 3 - A-CDM Interfaces for Cross-border ATFM

24. In practice, an A-CDM implementation should establish a roadmap for maintaining and improving its interfacing capability based on the most cost-effective solutions at the time to serve its users and stakeholders. A system-view approach with reference to the above options and the ICAO ASBU roadmap could be a reasonable choice.

25. Under the systems view, A-CDM can be implemented as a specific application of CDM in the airport environment and ATFM facilities are being developed in an ecosystem with a cross-border network of many advanced, legacy and aged systems that airports are physical nodes inside virtual ATFM nodes on the network.

26. A mature ATFM network should provide a platform for airport operators and air traffic management units to collaboratively apply the most effective and efficient ATFM measures with considerations of the A-CDM milestones in a timely manner. One example would be the use of Calculated

Take-Off Time (CTOT) from BO-NOPS (ATFM) and various milestones from B0-ACDM e.g. Target Off-Block Time (TOBT) and Target Start-up Approval Time (TSAT).

27. Targeting a common goal through the systems view, the systems engineering (an interdisciplinary field of engineering and engineering management) should be applied to holistically tackle both technical and operational complexities of A-CDM, in particular when A-CDM being involved in cross-border ATFM. Data exchange schemes in compliance with FIXM and SWIM would be part of the practical solutions. Service orientation is a means for integration across diverse systems. Ultimately, the silo effect caused by islands of A-CDM and ATFM systems can be eliminated.

28. System-wide predictability and situation awareness of air traffic will be the fruit results from interoperable A-CDM and ATFM based on common data models, i.e. FIXM. In long run, the continuous improvement of predictability based on the concepts and tools of data analytics will not only be useful for planning, strategic and pre-tactical phases of AFTM but also help accurate decision making for operations related to A-CDM and the tactical phase of ATFM. The roles and interactions for integrated A-CDM and ATFM is summarized in **Table A2-1**.

Table A2-1: A-CDM roles within the ATFM Operational Phases

	Planning	Strategic	Pre-Tactical	Tactical	Post-Ops
Time Frame	Continual	< 6 months > 1 day	1 day prior	Day of operations	Day After
ATFM Role	Strategic ATFM planning	Strategic DCB planning	AFTM Daily Coordination and Next Day Planning	Tactical ATFM	Post-Ops Analysis
ATC Role				Tactical ATC	
A-CDM Role			A-CDM Planning	A-CDM Operations	A-CDM Performance Analysis

29. With a view to delivering both the airport-based and network-based roles/functions, SWIM-compliant “enterprise services” can be applied to organizing distributed resources into an integrated solution that breaks down information silos and maximizes business agility. The service-oriented nature of SWIM modularizes ICT resources, creating the loosely coupled business processes of A-CDM and ATFM that integrate information across net-centric systems.

30. Being mutually dependent, a well-designed service-oriented architecture critically relies on the availability of business process solutions that are relatively free from the constraints of the underlying ICT infrastructure, because this enables the greater agility that businesses are seeking.

31. An SWIM-enabled application provides end users with more accurate and comprehensive information and insight into processes. It also offers the flexibility to access the service in the most suitable form and presentation factor, whether through the web browser or through a rich client. Dynamic applications are what enable businesses to improve and automate manual tasks, to realize a consistent view of customers and partner relations, and to orchestrate business processes that comply with internal mandates and external regulations.

32. Although SWIM is the external enabler entity of ATM and the benefits of SWIM arise from the end-user applications that make use of it and not SWIM itself, it can bring benefits by allowing

end-user applications from the simple to the most complicated to make full use of the complete ATM data. For a simple start on local scale to interface an A-CDM platform with ATFM, existing infrastructures built on open standards can usually be reused without great changes, although some harmonization issues will need to be addressed.

33. To institute SWIM as "enterprise services", systems engineering can help an A-CDM implementation to design and manage complex systems over their life cycles. The systems engineering process begins by discovering the real problems that need to be resolved, and identifying the most probable or highest impact failures that can occur – systems engineering involves finding solutions to these problems across the interdisciplinary domains of ATM. The outcome of such efforts will be an engineered system for integrated A-CDM and ATFM with a combination of SWIM-enabled components that work in synergy to collectively perform the net-centric CD

Appendix C - References

1. Manual on Collaborative Air Traffic Flow Management (Doc 9971), Third Edition, 2018

2. EUROCONTROL A-CDM Implementation Manual, Version 5, March 2017

3. Airport Collaborative Decision-Making: Optimisation through Collaboration, CANSO

4. IATA Recommendations for A-CDM Implementation

5. ICAO APAC A-CDM Implementation Plan - https://www.icao.int/APAC/Pages/eDocs.aspx

Appendix D – GANP 6th Edition A-CDM-B0/1

Available at https://www4.icao.int/ganpportal/ASBU

ICAO GANP PORTAL

ASBU ELEMENTS

ACDM-B0/1

☑ Functional Description ☑ Enablers ☑ Deployment Applicability ☑ Performance Impact Assessment

ACDM

ACDM-B0/1	Airport CDM Information Sharing (ACIS)	Operational
Main Purpose	To generate common situational awareness, which will foster improved decision making within aerodromes, by sharing relevant surface operations data among the local stakeholders involved in aerodrome operations.	
New Capabilities	Stakeholders will be able to collaborate and take actions towards the achievement of a set of defined milestones by being aware of the status of an individual flight measured against known target times and milestones.	
Description	This element represents the first collaboration step among stakeholders involved in aerodrome operations. It consists in the definition of common specific milestones for several flight events taking place during surface operations. The stakeholders involved have to, based on accurate operational data, achieve the agreed milestones.	
Maturity Level	Ready for implementation	
Human Factor Considerations	1. Does it imply a change in task by a user or affected others? No 2. Does it imply processing of new information by the user? Yes 3. Does it imply the use of new equipment? No 4. Does it imply a change to levels of automation? No	

PLANNING LAYERS

Pre-tactical | Tactical-Pre ops | Tactical-During ops

OPERATIONS

Taxi-out | Departure | Arrival | Taxi-in | Turn-around

DEPENDENCIES AND RELATIONS

Type of Dependencies	ASBU Element
Relation-information need	AMET-B0/1 - Meteorological observations products
Relation-information need	AMET-B0/2 - Meteorological forecast and warning products
Relation-operational benefit	SURF-B0/2 - Comprehensive situational awareness of surface operations

ENABLERS

Enabler Category	Enabler Type	Enabler Name	Description / References	Stakeholders	Year
Operational procedures	Operations	Surface operation milestones procedure	Reference: Manual on Collaborative Air Traffic Flow Management (ATFM) ICAO Doc 9971	Airport operator ANSP Aircraft operator Ground handling agent	2013
Ground system infrastructure	Airport systems	ACIS system	A simple A-CDM dialog system to a more advanced A-CDM Information sharing platform (ACISP) to achieve A-CDM information sharing.	Airport operator ANSP Aircraft operator Ground handling agent	2013
Training	-	Training requirements for ACIS	Training in the operational standards and procedures	Airport operator ANSP ATM network function Aircraft operator Ground handling agent	2013
Operational procedures	Phraseology	ACIS Phraseology	Phraseology for the implementation of ACIS. References: Procedures for Air Navigation Services-Air Traffic Management (Doc 4444)	ANSP Aircraft operator	2013

DEPLOYMENT APPLICABILITY

Operational conditions:

This element is expected to bring benefits in complex or even simple but constrained airports. Collaborative decision-making by information sharing can highly facilitate coordination of common operational solutions in order to improve access and equity to ATM resources.

Main intended benefits:

Type	Operational description	Benefitting stakeholder(s)
Direct benefits	Efficiency of operations	Airport operator, ANSP, Aircraft operator
	Improve situational awareness of airport operator, aircraft operator and ANSP	Airport operator, ANSP, Aircraft operator
Indirect benefits	Increased safety	Airport operator, ANSP, Aircraft operator

INTENDED PERFORMANCE IMPACT ON SPECIFIC KPAS AND KPIS

KPA	Focus Areas	Most specific performance objective(s) supported	KPI Impact	KPI

Appendix E – Feeder Airports concept

Note: this appendix is under review as must not be considered as final.

Purpose

1. The purpose of this document is to describe a hub – feeder concept for Airports that wish to explore the possibilities of integrating into a network pre-ACDM. This document will describe the concept, the benefits, and proposed pre-requisites.

Scope

2. The intended audience of this document is anybody who would like to know more about the integration of feeder Airports into a network.

Objectives

3. The purpose of the Feeder concept is to allow for a simple way of exchanging relevant and timely information between HUB & Feeder airports, thereby forming a network.

4. It could be used by feeder airports or smaller airports that have no plans to implement the Airport CDM Process.

The situation today – the problem

5. Before take-off, the accuracy of the flight data available to destinations airports & the network is based upon the EOBT from the ICAO flight plan and an average taxi-time. It is well known that EOBTs in flight plans are not always updated and that the taxi-time and runway-in-use are not always adjusted to the operational situation. This can result in a reduced accuracy of traffic predictions for the destination airport, especially during periods when operations are difficult at the airport of departure.

6. Flights may suffer from take-off slots restrictions and updates after they started pushback sequence or even taxiing. This can result in disturbing flight operations after the flight has received its departure clearance by late flight plan updates. This may result in extra workload within the Tower, APOC and extra delay for Aircraft Operators.

7. The destination airport will have no visibility on the true estimated arrival time of the flight and therefore its operational planning will be inefficient.

Hub- Feeder Airport Concept (Proposal)

What is it?

8. The best way for an airport to integrate into a network is to implement the Airport Collaborative Decision Making (A-CDM) process. However, airports that have no plans to implement the A-CDM process for whatever reason but still wish to exchange data with hub airports may do so as a feeder airport. Such an Airport may provide a reduced set updated flight information with a reduced set of advantages (compared to full CDM Airports).

9. A feeder airport can provide Target Take-Off-Time (TTOT) estimations, taking into account the local situation [ie actual off bloc time + actual taxi out time]. This would be available from the moment that the aircraft leaves the blocks.

Benefits of becoming a feeder airport

10. The Benefits for an airport to become a feeder airport are:

- Improved predictability
- Improved collaborative culture
- Facilitates migration to future full A-CDM without investing much resources as a full A-CDM implementation

11. The Benefits for the destination airport and network are:

- improved Traffic predictability in en-route ACCs,
- improved flight plan consistency
- improved situational awareness for AOs when the aircraft is at an outstation.
- improved estimated landing time estimates for Airports of Destination (ADES)

Pre-requisites for becoming a feeder airport

a. Variable Taxi-Time:

It shall be possible to automatically calculate the taxi-time for every flight. The taxi-time shall at least be dependent on the runway-in-use but preferably also on the stand or parking position.

By automatic calculation it means that the platform or application being used should have that level of functionality. An example would be an airport with runway constraints in relation to the geographical surroundings and airport layout [i.e apron vs runway and available taxiways].

In a case like this it is known that due to the proximity of apron to preferred departure runway a taxi of “XX” mins is set for all flights.

It shall be possible to globally extend the taxi-time with a number of minutes to cover for operational circumstances (e.g. adverse conditions, closure of taxi-way, etc.) during which taxiing takes longer than normal.

The provided taxi-time shall have a pre-agreed accuracy.

b. Actual Off-Block event:

The Actual Off-Block Time event shall be available for all flights.

It could be passed by the Turnaround manager, automatically detected (by e.g. A-SMGCS or Docking Guidance Systems), ACARS generated (first O of OOOI). It would also be acceptable if this event is consistently recorded into the TWR system by controller input which is part of the operational procedures.

The off-block event shall be available with a pre-defined accuracy.

c. Return-to-Stand:

In cases when aircraft has to return back to the stand (due e.g. a technical problem), it is important to inform the destination airport and network. This information is required to re-enable the acceptance of flight plan updates (e.g. DLA message).

For this reason, the Return-to-Stand shall be input into the TWR system as part of the operational procedures.

d. Communication with destination airport/FMU:

The TWR shall be ready to accept calls/questions for individual flights from destination airport/FMU, e.g. if an AO needs to file a DLA message after the flight has pushed back and the flight is taxiing.

Such calls will occur very infrequently but may be of great help in providing the best possible service to the Aircraft Operators.

e. Distribution of data.

The airport, usually the ATC TWR system, shall be able to transmit and receive messages via the AFTN network. If it is from an airport then other means of communication could be used, ie telephone coordination, email, SITA messaging.

Becoming a feeder airport

a. Data exchange

The data to be useful and meaningful the feeder airport should provide AOBT, TTOT, ATOT and an updated estimated landing time. This data can be initially taken from the daily schedules of the airport forming the plan. As flights are arriving and turning then the updated information should be re-calculated and exchanged.

There is effort involved in updating data, less if there is an automated platform which could be as simple as a workable spreadsheet.

Data collection and inputs need to be considered as this will for the basis for the updated TTOT.

b. Issues & things to consider

A few issues to be aware of:

- The AO and Handling Agent shall possibly adjust their working practices for filing DLA or CHG messages. These shall always be filed before the off-block event.
- In a return-to-stand scenario flight data updates should be considered. If the flight has an allocated slot then provisions for this update must be made.
- Provisions of the procedures may be mentioned as an AIC or in the AIP. This is to make Operators at the airport aware of the above mentioned requirements.

Integration of feeder airports

The integration of an airport as a feeder is mainly done by an information exchange between nominated unit (TWR or APOC) and the hub airport.

The minimum for information exchange could be anything from a simple meeting through to sophisticated automated solution. It would be envisaged at this stage that most exchanges would be via email [or other electronic means] or voice.

It is based upon operational procedures, systems and data elements.

The availability of variable taxi-time estimations and accurate recording of the off-block event, result in an improved view on the expected traffic for the hub airport and network and all its users.

It starts at push-back approval and ends at take-off.
