The Airport A-CDM Operational Implementation Description and Challenges

Omar Netto\textsuperscript{1,2}, Jorge Silva\textsuperscript{1,2}, Maria Baltazar\textsuperscript{2}

\textsuperscript{1}University of Beira Interior, Aerospace Sciences Department, Covilhã (Portugal)
\textsuperscript{2}CERIS, Instituto Superior Tecnico, Universidade de Lisboa (Portugal)

omar.netto@ubi.pt, jmsr@ubi.pt, mmila@ubi.pt

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Abstract

\textbf{Purpose:} This research aims to address an issue that today is a significant challenge for all signatory countries of the International Civil Aviation Organization (ICAO). The implementation of the areas for improving practices recommended in the Global Navigation Plan (GANP). More specifically on the theme of Airport Collaborative Decision Making (A-CDM), which involves three of the most critical stakeholders in the Air Sector, which are Airlines, Airports and Air Traffic Control Bodies.

\textbf{Design/methodology:} The strategy chosen to achieve the objective is to present the vision of the leading entities that represent the aviation area. Thus, the methodology of the Case Study, more precisely the Multiple Case Study, is one of the bases in the elaboration of the article, in the sense that analyses and recommendations prepared by Central Aviation Organizations are carried out, as well as by other entities that bring together the Sector members.

\textbf{Findings:} In addition to having a basis for the functioning of a Collaborative Decision Making (CDM) process within the Air Sector –because of the extreme dynamics of the sector–, readers will have a signal of the importance of having a systematic backing of document contents ICAO before starting any professional or research work. Mainly from the GANP document, a compass for these activities in the coming decades.

\textbf{Practical implications:} Academics and members of the Air Sector will have a brief reference and focused on the practical application of this topic, which still has very few approaches in academic research sources.

\textbf{Originality/value:} The educational form in which this article is sequenced, as well as the different views presented, can serve as a guide for the understanding of all those interested in the airline industry. Making it an original document in its content and of great value to its professionals and researchers.
Keywords: Airport, Operations, Global Air Navigation Plan (GANP), Airport Collaborative Decision Making (A-CDM).

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1. Introduction

The International Civil Aviation Organization (ICAO) advocates several areas of performance improvement in its Global Air Navigation Plan (GANP) to be implemented in the signatory countries in the coming decades. One of the most important is the Operations area. And within it, a module called Airport Collaborative Decision Making (A-CDM) of significant importance to Air Traffic Flow Management (ATFM). Professionals in their daily lives always make decisions aiming at increasing efficiency. However, the effects of such decisions based on individualistic behaviour may have an impact on the effectiveness of other entities. Thus, the A-CDM concept began more than a decade ago in Europe and its counterpart, and Surface-CDM in the U.S. established a new way to optimise airport operations through more efficient collaboration between all stakeholders. This new approach, based on transparency and information sharing, is now a well-documented, well-supported concept and accepted worldwide for tangible results at various airports.

A-CDM is a process that can provide a positive response to the problem of congested airports. It is supported by the International Civil Aviation Organization (ICAO), the Civil Air Navigation Services Organization (CANSO), the International Airport Council (ACI), and the International Air Transport Association (IATA). Today, manuals dealing with Future Air Navigation Systems (FANS) such as the Single European Sky Air Traffic Management Program (SESAR), the USA's Next Generation Air Transportation System (NextGen) and Japan's Collaborative Actions for Renovation of Air Traffic Systems (CARATS), already incorporate several variants of A-CDM. Each of these organisations and projects has developed a vision according to their specific needs and context. The A-CDM is a change of mindset and working methods to improve the performance of airport operations and provide better overall predictability, allowing the stakeholders to work together as a team for mutual benefit. The process is based on transparency and sharing of information among key stakeholders, starting with the establishment of collaborative work methods and practices (CANSO, 2016).

In the current ATM concept, when demand for traffic exceeds available capacity at an en-route airport or control centre, aircraft are retained at the airport, causing a lot of delays and ATFM slots troubles. A-CDM is predicted like an innovative concept of proactive decision-making in the air traffic system, which aims to replace the current centralised system of air traffic management with collaborative decision making in respect to the airport's airside operations. To establish such a system, involving all stakeholders in the air transport team, it is necessary, and, additionally, provide timely information to all system users. The main stakeholders in this system are Airports, ATC and Airlines (Steiner, Stimmac & Melvan, 2014).

The A-CDM approach, which involves ATC and Airports, is one of the fundamentals that will guide aviation in the coming years contained in the GANP. They are of vital importance for those in the Air Sector, especially occupants of management positions in the air traffic services, airports and operational areas of airlines so that they can interact operationally with the air traffic control organs and areas of airport operations. Thus, to achieve the objectives, set in processes of performance improvements, such as in Airport Operations, this theoretical basis is essential, as well as the understanding of the importance, diversity and flexibility of its application (Netto & Silva, 2018).

This paper seeks to describe and highlight the main characteristics and points that involve the operationalisation of an A-CDM, bringing the vision of the main implanters of the system today, such Europe and the USA, representatives of associations of the air sector, such as CANSO and IATA, and academics. Besides, considers
the contribution that the academy has given in the field of decision support, and collaborative decision using studies by Baker et al. (2001), as well as the work of Baltazar, Rosa and Silva (2018), which allows us to measure the effectiveness of the operational and decision-making processes.

It has practical, scientific, methodological, social and personal relevance. In practice, the results of this study can clarify and mark actions to members of the Air Sector. It can serve as the primary theoretical basis for those who should start work with ASBU Methodology and A-CDM. Scientifically, it can provide support for future academic research in the field.

2. Literature review

2.1. Methodologies

To facilitate the understanding, illustrating and giving more credibility, the methodology of Case Study, more precisely a Multiple Case Study, was adopted for the preparation of the article, which will allow us to present some analysis and solutions already performed at the international level.

However, to illustrate the article, it is interesting to highlight one of the most appropriate methodologies in studies and implementation of processes such as the one studied.

The characteristics of the Aviation Sector and, more particularly, the airports and the air traffic control services, always recommend collaborative actions applications. And the Collaborative Decision-Making (CDM), now widely adopted by ICAO, is a recommended process to be applied by managers and stakeholders in this process.

2.1.1. Multiple Case Study

• Use of case-study type research:

For Yin (2010), the use of a case study as a research method in various situations has the purpose of bringing to the knowledge individual, group, organisational, social, political and related phenomena. The differing need for case studies arises from the desire to understand complex social aspects, as it allows researchers to maintain the holistic and meaningful characteristics of real-life events. The case study is preferred when:

a) The type of research question is of the form "how" and "why";

b) When the control that the researcher has about the events is very reduced; or

c) When the temporal focus is on contemporary aspects and within the context of real life.

• Multiple case study:

According to Yin (2010), case studies can cover multiple cases and then draw a unique set of cross-case solutions. The same author considers that in some areas, multiple case studies have been considered a different "methodology" than single case studies. Then, it presents the advantages and disadvantages of the single case study:

a) As a positive fact believes that the evidence of the multiple case study is often found more vigorous, being then the study seen as more robust; and

b) As for disadvantages observes that the multiple case study cannot use for analyses that deal with critical, unusual, rare and revealing cases, typical of being studied as single cases and the fact that it may require more resources and time that the unique situation.

2.2. The GANP and ASBU Understanding

The ASBU methodology, according to GANP (ICAO, 2016), is an approach that aims to facilitate and, thus, enable all member states to move forward in their Air Navigation capabilities based on each of their specific operational needs. Such a block system will allow the sector to achieve global harmonisation, increase capacity and improve environmental efficiency—improvements that are requirements imposed by the growth of air traffic in all regions of the world—. Considering these needs, ICAO has developed such a comprehensive system of block improvements, mainly to ensure that aviation safety is maintained, enhanced and that ATM upgrading
programs can be effectively harmonised and not put any barrier to future aviation efficiency. And add to it, environmental gains and a reasonable cost of implementation (Figure 1).

These ASBUs incorporate a long-term perspective, as recommended in the ICAO air navigation planning primary documents:

a) Global Air Traffic Management Operational Concept (Doc 9854);

b) Manual on Air Traffic Management System Requirements (Doc 9882); and

c) Manual on Global Performance of the Air Navigation System (Doc 9883).

These documents establish clear operational objectives based on aircraft and ground services along with the avionics, data link and ATM systems requirements to achieve them. The overall strategy serves to provide industry transparency and essential safety for operators, equipment manufacturers and ANSPs (ICAO, 2016).

ASBUs are not comprehensive, nor are they an umbrella system, but remain flexible modules that can be used by States according to their individual operational needs. One of the hallmarks of ASBUs is that they define technologies and procedures that are calculated to improve operational performance, mainly when the need came for an operational problem to be solved. The goal is to achieve global harmonisation and interoperability of air navigation (Abeyratne, 2014).

The primary foundation of the concept is linked to four specific issues and interrelated areas of performance improvement:

a) Airport operations;

b) Interoperable systems and data at the global level;

c) Optimum capacity and flexible flights; and

d) Efficient flight paths.

These four (4) Performance Improvement Areas (PIAs) (Figure 1), and the so-called ASBU modules associated with each were organised into a series of four blocks (Block 0, 1, 2 and 3) based on timelines for the variable which contain, as illustrated in Figure 2. They refer to availability schedules for a group of operational improvements. The ASBU framework is ICAO’s systems engineering approach to achieving interoperability and harmonisation of global ATMs. Block Upgrades are the product of inclusive and extended collaboration between ICAO, ANSPs, member states and industry stakeholders around the world. Some air navigation improvement programs carried out by ICAO Member States –such as SESAR, NextGen, CARATS, SIRIUS and
others in Canada, China, India, and the Russian Federation— are planned to be implemented with the ASBU structure. Block Upgrades present target implementation deadlines for sets of operational improvements, referred to as modules. A single module defines a unique resource (operational improvement), its necessary technologies and procedures. Each block update was organised into a set of individual modules linked to one of the four PIAs (CANSO, 2013).

The technologies and procedures for each Block were organised into Single Modules, based on their respective Performance Improvement Areas. In systems engineering developed by ICAO for its Member States, they only need to consider and adopt the Modules appropriate according to their operational needs. Not all states must implement each Module. Within ICAO, ICAO will be working with its Member States to support and guide, to determine, precisely according to their operational requirements, which capacities they should have in each of their systems (ICAO, 2016).

One of the most specific and valuable features of the ASBU strategy is flexibility. This flexibility allows the various member states to evaluate different modules so they can implement the selected ones according to their specific operational requirements. Not all modules will be needed in all parts of the world. The implementation is based on several factors, which include needs, resources, and level of readiness (Abeyratne, 2014).

Another critical point to emphasise, about using ASBUs is that while the improvement of operations involves many challenging actions, the process can be much less costly than technological solutions. In the ASBU case, improved operations represent a win for the industry, a quest for corporate responsibility and a victory for the environment. The result is an essential example of finding a balance between these two goals, often opposed. The ASBU is a work in progress and will need to be carefully monitored for a successful implementation, as well as to verify how the methodology can facilitate compliance with the goals of sustainability and compatibility with
economic growth. It should probably be consolidated as a "learning by doing" process, which will depend on the flexibility embedded in policy implementation (Lutte & Bartle, 2017).

2.3. Collaborative Decision-Making (CDM)

The A-CDM concept is based on a general idea about collaborative actions (CDM). From this concept, the ICAO starts to apply it in aviation.

The implementation of Airport-CDM involves a change in procedures and a cultural shift in all the interested parties involved. They further state that the system is based on two main elements (Steiner, Stimac and Melvan, 2014):

a) Predictability of events – Which would result in the optimisation of each process related to aircraft and airport operations; and

b) On-time performance of operations – Which would influence the increase in capacity of the airport and ATC on one side and, more directly, the efficiency of airlines and the use of aircraft on the other.

CDM at congested airports has demonstrated that considerable improvements could be gained at airports by air transportation agents, without sacrificing internal objectives and the means for different operators to achieve them. The goals of A-CDM are to reduce delays and improve system predictability while optimising the utilisation of resources and reducing environmental impact. An airport is considered a CDM airport when A-CDM Information Sharing (ACIS), Turn-Around Process (CTRP) and Variable Taxi Time Calculation (VTTC) concept elements are applied at the airport. In Europe, airport CDM has been implemented successfully at several airports and are expanding. Collaborative Air Traffic Management is now a key component in both SESAR and NextGen (Marzuoli, Laplace & Féron, 2013).

2.3.1. CDM – ICAO Overview

According to ICAO documentation (DOC 9971) dealing with the subject, collaborative decision making (CDM) defines a process focused on how to decide on a course of action articulated between two or more community members. Through this process, members of the ATM community share information related to that decision, interact, establish everyday choices and apply the approach and principles of decision making. The overall purpose of the process is to improve the performance of the ATM system while balancing the needs of individual members of the ATM community. It defines the following CDM features (ICAO, 2014):

a) The CDM is a support process always applied to other activities, such as demand/capacity balancing, and can be used throughout the timeline of strategic planning activities (for example, infrastructure investments) to operations in real-time;

b) CDM is not a goal but a way to achieve the processes performance objectives that it supports. These performance objectives should always be agreed collaboratively;

c) While sharing information is an essential element for the CDM, such sharing is not enough to fully realise the CDM and achieve its objectives;

d) To ensure that the collaborative decisions are made expeditiously and equitably, the CDM also requires pre-defined and agreed on procedures and rules;

e) The CDM ensures that decisions are made transparently by the best available information, as provided by the participants at the right time and in a precise manner;

f) The development and the operation of a CDM process follow the following typical phases:

- Identification of the need to carry out a CDM;
- CDM analysis;
- CDM specification and verification;
- The case of CDM performance;
• Implementation and validation of the CDM; and
• The operation, maintenance, and improvement of CDM (continuous).

Thus, CDM is one of the adequate processes for the studies, decision-making processes, and implementation of the factors necessary for the operation of these new members of the Air Sector. In fact, such a sector is a regular use of this process.

2.4. Airport Collaborative Decision Making (A-CDM)

Collaborative decision-making at airports (A-CDM) is a process that provides a concrete response to the problem of congested airports. In the last years, it has become a key process supported by the International Civil Aviation Organization (ICAO), the International Airport Council (ACI), the International Air Transport Association (IATA) and the Civil Air Navigation Organization (CANSO).

2.4.1. The ICAO Normative Measures

Collaborative decision making at the airport (A-CDM) is a set of processes developed from the philosophy of collaborative decision-making in aviation and is applied to operations at aerodromes. The A-CDM allows airport and aircraft operators, air traffic controllers, ground handling agents, pilots, and traffic flow managers to exchange operational information and work together to manage aerodromes, A-CDM can also improve the planning and management of en-route operations. The A-CDM defines the rules and procedures used by aerodrome participants to share information and collaborate. These, in turn, help optimise the use of all aerodrome resources, reduce arrival and departure delays, and improve predictability during regular and irregular operations. The A-CDM enables all stakeholders to streamline their operations and decisions in a collaborative environment, considering their preferences, known constraints, and the predicted situation. The decision-making process is facilitated not only by the sharing of accurate and timely operational information through a standard set of tools but also by the application of agreed procedures and procedures. The primary objective of the A-CDM is, therefore, to generate a shared situational awareness that will foster better decision-making. The A-CDM, however, does not dilute or eliminate the responsibilities associated with decisions. Decisions are still made, and A-CDM partners remain accountable for their actions. They are, however, taken collaboratively and, as a result, are better understood and applied (ICAO, 2014).

2.4.2. The IATA Overview

A-CDM is designed to improve overall airport and network efficiency through improved turnaround processes, harmonising sequencing, surface and departure management. IATA supports common objectives and performance metrics between all A-CDM stakeholders, based on mutually agreed targets (IATA, 2018):

a) Airport Operations
• Increased Departures and Arrivals punctuality and airport slot adherence;
• Efficient use of infrastructure, e.g. stands and gates;
• Accelerated operational recovery in adverse conditions or other disruptions; and
• Reduced environmental impact, e.g. emissions and noise.

b) Aircraft Operators
• Daily programs of flight operations and turnaround times on schedule;
• Possible schedule disruptions predicted early, thus managed efficiently;
• Preferences and priorities are taken into account; and
• Reduce taxi fuel burn.

c) Ground Handling
• Enhanced punctuality of operations;
• Maintenance of Service Level Agreements; and
2.4.3. The EUROCONTROL/SESAR Overview

According to EUROCONTROL (2017), an airport is considered a CDM Airport when Information Sharing, Milestone Approach, Variable Taxi Time, Pre-departure Sequencing, Adverse Conditions and Collaborative Management of Flight Updates Elements are successfully implemented at the airport. The future European ATM system will depend on the full integration of airports like nodes in the network. This integration implies enhanced airport operations, ensuring a seamless process through collaborative decision-making (CDM), in normal conditions, and through the further development of collaborative recovery procedures in adverse conditions. In this context, this feature addresses the enhancement of runway throughput, integrated surface management, airport safety nets, and total Airport management. It also introduces some initial concepts, above, which are basic definitions to guide the implementation of the operational concepts, which are meticulously explained in the 363 pages of the Airport CDM Implementation – Manual. The next five items are part of the referenced manual (EUROCONTROL, 2017).

EUROCONTROL Manual - basic definitions

Airport Collaborative Decision Making is the concept which aims at improving Air Traffic Flow and Capacity Management (ATFCM) at airports by reducing delays, improving the predictability of events and optimising the utilisation of resources. Implementing airport CDM allows each airport CDM partner to maximise their decisions in collaboration with other CDM partners, thus knowing their preferences and constraints and the actual and anticipated situation. Decision making by Airport CDM Partners is then facilitated by sharing accurate and timely information and by simple procedures, mechanisms and tools. Airport CDM concept is divided into the following Elements:

a) Information Sharing;

b) Milestone Approach;

c) Variable Taxi Time;

d) Pre-departure Sequencing;

e) Adverse Conditions; and

f) Collaborative Management of Flight Updates.

SESAR Airport Operations Center (APOC)

SESAR is developing several solutions within the airport-collaborative decision-making (A-CDM) framework to improve information sharing at airports, thereby improving the efficiency and predictability of flights. One such answer is the airport operations centre (APOC), which brings together the main airport stakeholders to become a platform for stakeholder communication and coordination, based on shared knowledge. Instead of islands of potentially conflicting decision-making, the APOC provides a coordinated capability, supported by technology
High-performing airport operations

Initial airport collaborative decision-making (A-CDM) improves the overall efficiency of operations at an airport, with a focus on the aircraft turnaround and pre-departure sequencing process. It facilitates working together between different partners (airport operators, aircraft operators/ground handlers, ATC and the Network Manager (NM) and allowing the transparent sharing of data.

Airport CDM Information Sharing Platform (ACISP)

The Airport CDM Information Sharing Platform (ACISP) is a generic term used to describe the means at a CDM Airport of providing Information Sharing between the Airport CDM Partners. The ACISP can comprise of systems, databases, and user interfaces.

Airport CDM Partner

An Airport CDM Partner is a stakeholder of a CDM Airport, who participates in the CDM process. The main Airport CDM Partners are:

a) Airport Operator;
b) Aircraft Operators;
c) Ground Handlers;
d) De-icing companies;
e) Air Navigation Service Provider (ATC);
f) Network Operations; and
g) Support services (Police, Customs and Immigration, etc.).

2.4.4. The FAA/NextGen Overview

CDM in terms of traffic management between flight operators and the FAA has been in place since the mid-1990s. Recent application of surface traffic management projects has demonstrated the potential efficiency and environmental benefits that can be gained from the CDM process. The inclusion of other stakeholders, including airports. Airports have become increasingly active regarding CDM activities, and it is a crucial element in aircraft movement management, door management, ground service equipment coordination, defrost operations, special events and asphalt delays. Many consider that ACDM is simply a tool and a means of coordination through technology that is only applicable and achievable by major airports; However, it can be used by smaller airports as it helps airports of all sizes with their perception of the situation. Smaller airports can have a significant impact during IROPS, and it is their ability to get information faster that enables them to activate their plan earlier and presumably more effectively, with the least possible impact on airport operations or airports affected passengers (Vail et al., 2015).

According to U.S. Airport Surface Collaborative Decision Making (CDM) Concept of Operations (ConOps) in the Near-Term (FAA, 2012): the Surface Domain is a Core Element of the NextGen Implementation Plan (NGIP) and, the Airport Surface CDM concept will enable U.S. airports to make optimum use of available airport capacity. They are thereby increasing traffic management efficiencies across the National Airspace System (NAS).

The concept describes the need for timely sharing of relevant operational data among Surface CDM Stakeholders to improve situational awareness and predictability, through a shared understanding of "real" airport demand, and predicted imbalances between the demand and public airport capacity. At the core of this concept is a set of well-defined capabilities and procedures, which facilitate the proactive management of surface
traffic flows and runway departure queues, via the continuous assessment of airport capacity and demand. The skills and processes are expected to improve the efficiency of surface traffic flow at U.S. airports while reducing environmental impacts. It is understood that Surface CDM capabilities and corresponding procedures must be transparent, flexible, agile, and, equally important, capable of supporting the distinct needs of individual U.S. airports and the unique business models of different Flight Operators. The concept includes the following capabilities and procedures, which build on one another (FAA, 2012):

a) Transparent and real-time sharing of all up-to-date and anticipated operational information aimed at improving situational awareness among all stakeholders, as well as enabling continuous and accurate predictability of airport demand and capacity;

b) Tactical and strategic management of aircraft traffic flow at airports using a departure reservoir management capability to manage departure queues better to avoid excessive taxi departure times and improved the departure efficiency;

c) Management of incoming traffic flows to increase the total transfer rate of the airport and allow a balanced demand for arrivals and departures;

d) Analysis, measurement and monitoring capabilities that can enable Stakeholders to understand better operational performance and NAS impact using a "scorecard" that provides an objective and transparent measure of local Stakeholder performance; and

e) Global harmonisation which facilitates standardisation across international Airport CDM programs and the U.S. Surface CDM concept.

3. A-CDM Operational Implementations and Characteristics

3.1. Framework

The planning and operation of an A-CDM should always consider a preliminary assessment of the current operational constraints and which critical milestones of the implementation, and corresponding milestone, should be adjusted to mitigate such restrictions and improve the operating conditions of the aerodrome and air traffic flow.

Airports are considered as CDM airport when the follows concept elements are applied: A-CDM Information Sharing (ACIS), Turn-Round Process (CTRP), and Variable Taxi Time Calculation (VTTC). CTRP describes the flight progress from the initial planning until take-off by defined 'milestones' to allow monitoring of significant events. The Flight Update Messages (FUMs) and Departure Planning Information (DPI) inform CDM partners about the flight progress. The flight between the period of milestone that defines aircraft landed, and milestone aircraft off-block is a complex task as situational awareness needs to be established across multiple subsystems of different organisational and operational structures having their causal and intentional domain constraints. 'Subsystems' here refer to actors that can be airport operators, airline company, air traffic control, ground handler, and Central Flow Management Unit (CFMU). Besides, all terminal and ramp processes have operational interdependencies, e.g. methods can typically not be parallelised, as well as legal requirements, e.g. one side of the aircraft must be clear of obstructions to ensure that firefighting access is always possible (Groppe, Pagliari & Harris, 2010)

3.2. Stakeholders recommendations

Corrigan et al. (2014) state some consolidated overview recommendations that were accepted by the stakeholders at the airport in the A-CDM implementation:

a) Appoint a dedicated A-CDM coordinator in all stakeholder organisations (airport, ground handling, airline, ATC, fuel, cleaning, catering etc.) that can attend all project meetings;

b) Each coordinator develops a communication strategy for their respective organisations. Create a project team to develop an overall airport-wide communication strategy;

c) Create a sense of collective leadership across all actors to ensure a win-win attitude for all actors;
d) Clearly define and agree on objectives and key performance indicators at global and individual stakeholder organisations;

e) Prioritise the visiting of other stakeholders’ operational space regularly. Make this a fundamental tool for ensuring a common operational picture between stakeholders. This kind of action may be developed into a regular programme of cross-training;

f) Develop an agreed strategy for rewarding collaborative behaviour and discouraging non-collaborative practice;

g) Develop a dedicated training programme to deal with the softer issues of communication and collaboration; and

h) Address the issue of what communication support and methods are required to support the turnaround process operations.

3.3. A-CDM operational implementation partners/data responsibilities

Airport CDM Implementation Manual considers that in A-CDM Operational Implementation, the partners are the primary sources of data provision to the Airport CDM Platform.

Below is a list of partners and associated data (EUROCONTROL, 2017):

a) Aircraft Operator/Ground Handler
   • Aircraft movement data
   • Priority of flights
   • Changes in turn-round times
   • TOBT updates
   • Planning data
   • Information concerning de-icing
   • Flight plans
   • Aircraft registration
   • Aircraft type
   • Flight type

b) Airport
   • Slot data, including relevant information such as:
     o Aerodrome of Destination (ADES); and
     o Scheduled Off-Block Time (SOBT)
   • Stand and gate allocation
   • Environmental information
   • Special event
   • Reduction in airport capacity

c) Network Operations
   • Data from flight plans
   • Slot Allocation Message (SAM)
   • Slot Revision Method (SRM)
   • Flight Update Messager (FUM), containing the Flight Status/Estimating Landing Time (ELDT) including:
     o change (CHG);
     o or cancellation (CNL) messages
d) Air Traffic Control
   - Real-time updates for Estimating Landing Time (ELDT) or Target Landing Time (TLDT)
   - Actual Landing Time (ALDT)
   - Runway and taxiway condition
   - Taxi times and SID
   - TSAT
   - TTOT
   - Runway capacity (Arrival/Departure)
   - A-SMGCS data/radar Information

e) Other Service Providers
   - De-icing companies (estimated and actual times related to de-icing)
   - MET Office (forecast and practical meteorological information)
   - And others (fire, police, customs, fuel etc.)

Figure 3. A-CDM operational implementation – partners and data responsibilities (Eurocontrol, 2017)

3.4. The FAA Operational Approach

3.4.1. Implementation CDM at Airports

According to Guidebook for Advancing Collaborative Decision Making (CDM) at Airports (Vail et al., 2015), to perform ACDM either as a leader or partner, airports will be required to commit financial and staff resources to the effort. A-CDM is also a process that may require expanded communications and enhanced communications/outreach programs. Thus, it is desirable for the airport to assign specific staff to lead and track A-CDM activities. During the implementation of A-CDM, it is essential that airport staff understands management’s goals and objectives and the airport's commitment to A-CDM. Not unlike most complex programs and efforts, such as the implementation of Safety Management Systems (SMSs), A-CDM is a change in the way airports do business and will require staff training to assure effectiveness. In other words, airport staff will need to be trained on A-CDM background and procedures before it can successfully be deployed. They recommend three necessary steps to start an A-CDM project (Vail et al., 2015):
a) Step One - Problem Identification: Implementation of A-CDM begins when an operational problem or issue is identified; A-CDM can also be used to address problems proactively, i.e., before they exist. For example, hazard material (HAZMAT) or security issues are treated much more effectively when a plan exists to address such problems. The airport work unit responsible for implementing A-CDM identifies the subject(s) that could potentially arise and that A-CDM could address. This list of topics will help determine which stakeholders need to be included in the A-CDM process.

b) Step Two - Developing the A-CDM Approach: Identifying what historical and real-time data information is needed to develop and implement the plan.

c) Step Three - A-CDM Implementation: Execute the plan, including the identification of each organisation and their responsibilities, the existing facilities, data and infrastructure identification, such as automated decision support, and plan execution.

3.4.2. The FAA Milestones
The U.S. Airport Surface Collaborative Decision Making (CDM) Concept of Operations (ConOps) in the Near-Term considers three key milestones to be found in the operation of a Surface CDM (A-CDM) that need to be completed before a flight can depart.

These milestones are (FAA, 2012):

a) Flight Planning
   • Relative to the milestone of filing a flight plan, network-wide resource planning enables a Flight Operator to achieve maximum utilisation of its resources by adapting to changing conditions based on accurate, timely information. For example, Flight Operators may use airport aircraft surface surveillance data, integrated with airspace and National Airspace System (NAS) status data, to detect and understand the nature of any demand/capacity imbalances affecting airport surface traffic.

b) Pushback
   • Relative to the milestone of pushing back from a gate/parking stand, it is anticipated that the participating Stakeholders will share the following information:
     o Scheduled Off-Block Time (SOBT);
     o Earliest Off-Block Time (EOBT);
     o Updated flight intent information;
     o Operating limitations affecting the departure of an aircraft;
     o Actual Off-Block Time (AOBT); and
     o Access to pushback and other specified event data.

c) Taxiing on the Airport Surface
   • Taxiing to a Holding Area - A gate may be needed for an arrival, making it necessary to push back a departure earlier than otherwise would be required. In such cases, Ramp Control and ATC coordinate as essential to taxi the aircraft to the designated AMA holding area. Using surface surveillance and flight intent information, Surface CDM monitors current and predicted the capacity of the holding areas. Three notifications are provided to subscribing Stakeholders to improve their situational awareness regarding the designated Airport Movement holding areas.

3.5. The Eurocontrol Milestone Approach Concept Element
In the processes of A-CDM, it is common to use the term milestone, widely used in Project Management. It originates from the stones used to mark the distances at the edge of a road or path. In the cases of A-CDM are used as determinant milestones of each activity (termination of some stage and changes of phase, transition or completion of steps within the process).

The Milestone Approach Element describes the progress of a flight from the initial planning to take off by defining Milestones to enable close monitoring of significant events. The aim is to achieve an everyday
situational awareness and to predict the forthcoming events for each flight with off-blocks and take off as the most critical events. A total of 16 essential Milestones have been defined. The list of Milestones is indicative; more milestones may need to be included to cover for extra information up-dates on critical events, such as de-icing. Local procedures may dictate that some milestones may not be required and are therefore considered as not highly recommended. For each milestone, there are Time References, previously defined or that vary according to each airport, which should be presented and systematically updated to all stakeholders. The defined Milestones are presented in Table 1 (EUROCONTROL, 2017).

| Nº  | Milestones                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1/HR| ATC Flight Plan activation      | The ICAO flight plan is submitted to the ATC. At this time the flight is activated on the Airport CDM Platform, and all available information is processed. Usually, this occurs 3 hours before the EOBT. However, it may be later. In many cases, a repetitive flight plan (RFPL) is already in the database covering daily or weekly flights.                        |
| 2/HR| Estimates Off-Block Time (EOBT); 2 hs before | At EOBT -2 hr most flights will be known in the Airport CDM Platform including if they are regulated or not. If the flight is regulated, a Calculated Take-Off Time (CTOT) is issued at EOBT –2h.                                                                                               |
| 3/HR| Take Off from outstation        | The Actual Take-Off Time (ATOT) from the outstation (Departure Aerodrome - ADEP). The outstation provides ATOT to the Network Operations and Aircraft Operator.                                                                                                                             |
| 4/HR| Local radar update              | The flight enters the FIR (Flight Information Region) or the local airspace of the destination airport. This information usually is available from the Area Control Centre (ACC) or Approach Control Unit that is associated with an airport. The radar system can detect a flight based upon the assigned SSR code when the flight crosses a defined FIR/ATC boundary. |
| 5/HR| Final approach                  | The flight enters at Final Approach phase to the destination airport. This information usually is available from ATC. The radar system detects a flight based upon the assigned SSR code and identifies when the flight crosses either a defined range/position or passes/leaves a predetermined level.                     |
| 6/HR| Landed                          | ALDT – Actual Landing Time. It is the time that an aircraft touches down on a runway. Provided by ATC system or by ACARS from equipped aircraft.                                                                                                           |
| 7/HR| In-block                        | AIBT - Actual In-Block Time. It is the time that an aircraft arrives in blocks.                                                                                                                                                                                                                                                                           |
| 8/R | Ground handling starts          | Commence of Ground Handling Operations (ACGT). Specific to flights that are the first operation of the day or that have been long term parked. For flights that are on a normal turn-round ACGT is considered to commence at AIBT.                            |
| 9/R | Final confirmation of TOBT       | The time at which the Aircraft Operator or Ground Handler provide their most accurate TOBT considering the operational situation. The information is furnished *(t) minutes before EOBT. Where *(t) is a parameter time agreed locally.                                           |
| 10/HR| Target Start-Up Approval Time issue | The time ATC issues the Target Start-Up Approval Time. The information is furnished (t) minutes before EOBT, where (t) is a parameter agreed locally.                                                                                                  |
| 11/R| Boarding starts                 | The gate is open for passengers to start boarding, boarding can take place via air-bridge/pier, aircraft steps, or coaching to a stand.                                                                                                                                                                                                                     |
| 12/R| Aircraft ready                  | The time when all doors are closed, boarding bridge removed, push back vehicle connected. The aircraft must be ready to taxi immediately upon TWR instructions reception.                                                                                                                                                                                      |
| 13/R| Start-Up request                | The time that the start-up is requested.                                                                                                                                                                                                                                                                                                                                                                           |
| 14/R| Start-Up approved               | The time that an aircraft receives its Start-Up approval.                                                                                                                                                                                                                                                                                                                                                               |
| 15/HR| Off-block                       | AOBT – Actual Off-Block Time. The time the aircraft pushes back/vacates the parking position (Equivalent to Airline/Handler ATD – Actual Time of Departure ACARS=OUT).                                                                                                                                  |
| 16/HR| Take off                        | ATOT – Actual Take-Off Time. The exact time that an aircraft takes off from the runway.                                                                                                                                                                                                                                                                                                                                  |

HR: Highly Recommended or Mandatory  
R: Recommended or Optional Milestone

Table 1. Milestones Descriptions. Airport CDM Implementation (Eurocontrol, 2017)
4. Conclusions

As can be seen, A-CDM is a process, not a project, a process that when implemented brings excellent operational advantages to air operators, airports and airspace control, consequently to the final customer, the passenger, who is the biggest beneficiary of the improvements implemented (Figure 4). Economic and environmental factors are also huge components favourable to deployment.

The complexity of a CDM deployment at large airports, receives several approaches from signatory countries and their ATM Systems, based on the recommendations of the ICAO Global Air Navigation Plan. In all of them, especially those of greater importance, we have seen confluent points that, regardless of airport size, should always be part of A-CDM processes. The process will always involve three significant stakeholders: airport, air traffic control and air carriers, all connected around a regulatory entity and the application of the Operational Concepts (ConOps) they recommend, applicable for each State.

In the implantation we also see integrating factors, practically mandatory, in the implantation in large airports, as: the stakeholders that will be involved; the milestones (which the FAA points to in three broad groups and divides them after, in a systematic way); and, on its part, the milestones that Eurocontrol points out in sixteen notable brands, of which ten are Highly Recommended.

The process, now implemented in almost a hundred airports around the world, will require later interaction with smaller airports as well. This is because they are also feeders of the system. For the gears to function correctly, they must also have processes for control and transfer of information and data, in a systematic and integrated way to the extensive world air traffic system.

It is, therefore, a matter for discussion that the next steps to be taken in the global A-CDM processes are aimed at airports with lower aircraft and passenger movement capacity that are currently A-CDM. It is a challenge for future research work that you may hear from the global airline industry as to how this complex process could be simplified to apply it quickly and on a smaller scale. As reducing the number of stakeholders and compacting the milestones now recommended in airports of lower movement. Always considering CDM in a general way.
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