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Guidelines on Airport-Collaborative Decision Making (A-CDM) Key Performance Measures

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Introduction

Airport collaborative decision-making (A-CDM) is a programme which aims to improve the efficiency of airport operations by optimising the use of resources and improving the predictability of events at airports. This is achieved via real-time information sharing between airport operators, aircraft operators, ground handlers and air traffic control, and involves the implementation of a set of operational procedures and automated processes.

Successful A-CDM deployments can improve airport efficiency, capacity and environmental protection performance and therefore the performance of A-CDM is important to all stakeholders. Being able to gather data and measure how expectations are being met is imperative to showing return on investment, not only for the initial cost of A-CDM implementation, but also for the ongoing engagement and improvement of A-CDM at an airport.

The aim of this document is to put in place a structured approach – or Performance Framework – for measuring A-CDM performance, aligning objectives with performance criteria.

As A-CDM is about delivering benefits to all stakeholders, this document also sets out how air navigation service providers (ANSPs) can maximise the benefits of A-CDM. Benefits to aircraft operators, such as shorter taxi times, less fuel burn and ultimately to less cost, are often cited but the benefits to air navigation service provision are also considerable. The document provides recommendations on the areas where A-CDM can bring benefit to ANSPs, and provides advice on how to measure this benefit.

1
Create a Performance Framework

A-CDM implementation involves multiple stakeholders, with different expectations of what benefits A-CDM will bring.

Typically, the airport operator wants to see improvement in resource utilisation, i.e. better gate/stand utilisation and the airlines want to see improved on-time performance, as well shorter taxi times, as this can lead to less cost for fuel.

For the air navigation service provider, the expectations are not as clear. Traditionally A-CDM implementation does not fully address the procedures and role of the ANSP in the early stages of the project, these emerge at a later stage. This means initial expectations are often limited.

No matter what those expectations are or when they emerge, to achieve A-CDM best practice it is imperative to express these as commonly agreed objectives as early as possible in an A-CDM project. This is one of the cornerstones to A-CDM success for several reasons:

1. It compels all stakeholders to clearly express their expectations and why this is important at the same point
2. An A-CDM project can take a while to implement so an established record of initial expectations and objectives focuses efforts
3. It helps to structure an informed framework that breaks down measurable objectives

CANSO recommends any A-CDM project to establish a so-called Performance Framework to help structure the work of defining objectives, also called Key Performance Objectives, and to break them down into Key Performance Indicators (KPIs) so they can be measured.

The Performance Framework in itself helps to structure the approach so that everyone involved gets a better understanding of what is being measured, how it will be done and the expected result.

This does not need to be overly complex. Figure 1 illustrates a framework that allows for the structuring of Key Performance Areas, Key Performance Objectives, and Key Performance Indicators (KPIs).

As detailed, a Key Performance Area can have many Key Performance Objectives, which can in turn also have many Key Performance Indicators.

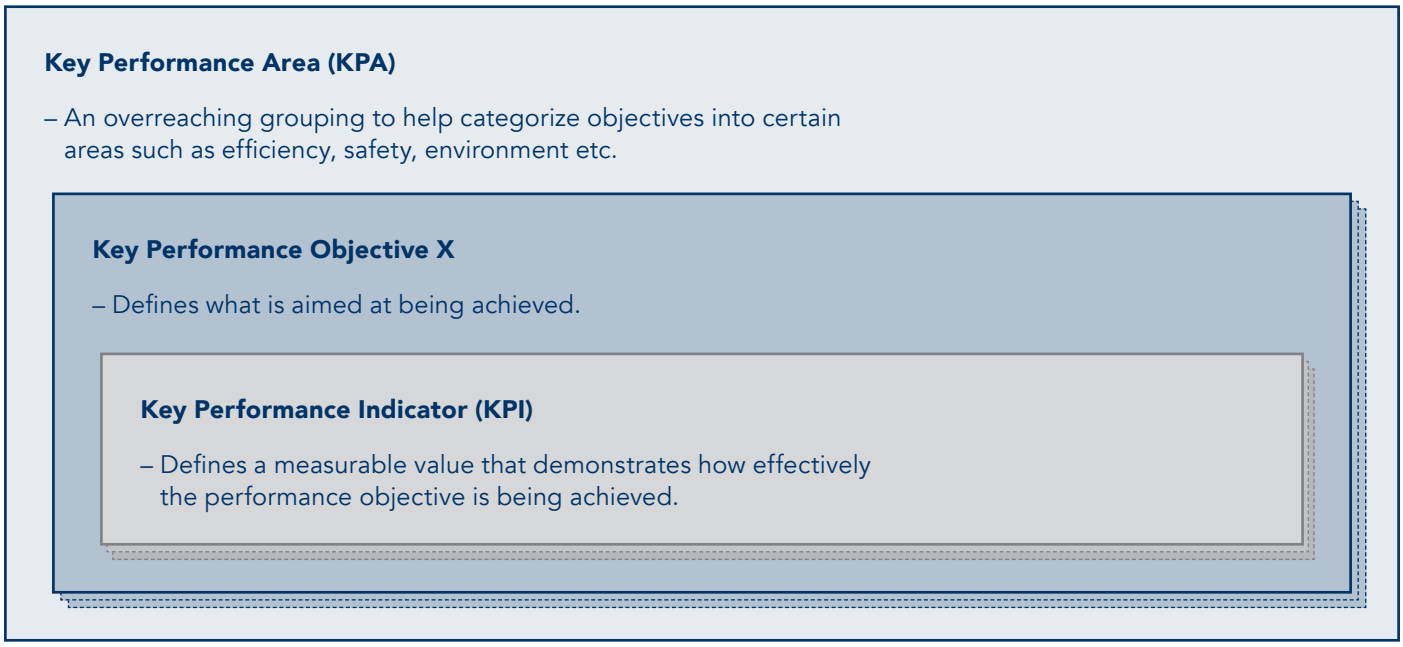

Figure 1 – Key Performance Area Framework

Defining the Key Performance Indicators is a critical step in the process and having a well-defined way of doing this is key. Figure 2 provides a KPI template that helps KPI definition.

It is important to note that as the A-CDM project starts, the Performance Framework with Key Performance Objectives and KPIs, does not need to be perfectly defined. Just as the overall implementation of A-CDM evolves, including defining procedures, sharing information and adapting/putting systems, the work of putting a Performance Framework in place is also iterative.

The most important thing is that this work is addressed as early as possible in the project and not at the end.

KPI Name	The name of the KPI
Purpose / Value	Defines what the purpose/value of the KPI is
Expected result	Defines what the expected results from the KPI should be
Data requirement	Defines what the data requirement to calculate the KPI is
Formula	Defines the formula to calculate the KPI
KPI Format	Defines the format in which the KPI is presented
Tips/Warning	Provides any useful tips of warnings that are good to think about for the KPI
System requirements	Provides requirement on systems related to the data requirements

Figure 2 – Key Performance Indicator Template

2
Establish a Baseline to Measure Performance

As part of measuring performance improvements, it is vital to establish a baseline to measure against. Without one, it will be impossible to fully and accurately measure how A-CDM procedures have improved the operations.

Example:

- With the implementation of A-CDM one objective is to decrease taxi times for outbound flights and this will be measured from actual off block time to actual take off time. However, without knowing what the current performance is in terms of taxi times it will be impossible to say if the objective is met or not – hence the need for setting a baseline.

When setting the baseline it must be recognised that:

- Setting a baseline is not trivial as many factors change at an airport, e.g. number of movements, the airport layout, number of gates, ground service equipment, procedures, etc, all impacting operations. When setting a baseline and doing post A-CDM implementation analysis, this also needs to be taken into account.
- Not all Key Performance Indicators can be measured prior to the A-CDM implementation as new data elements are being introduced to support the procedures. Examples are the Target-Off Block Time (TOBT) and the Target Start-up Approval Time (TSAT), which both are introduced with the A-CDM procedures. The recommendation is that Performance Indicators that relate to new data elements are part of a second baseline (further explained below).

It is recommended that two baselines are established:

- One prior to the implementation of A-CDM, where Key Performance Indicators that do not rely on data elements introduced with A-CDM procedures are measured. This will set the benchmark for current operations so that post-implementation comparison is feasible.
- A second just at the introduction of A-CDM procedures, where benchmarking of the all Key Performance Indicators is done. This will serve as the basis for how well the A-CDM procedures in themselves improve over time.

Figure 3 exemplifies this approach where two baselines (B1 and B2), related to various performance areas are established and how post-implementations measurements are comparable to these baselines.

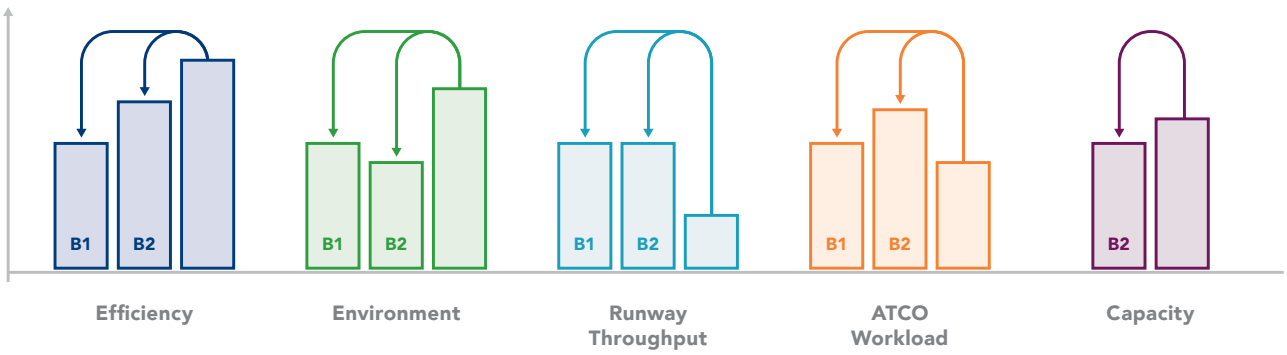

Figure 3 – Baseline Approach

3
Set a Reporting Mechanism

One of the fundamental principles of A-CDM is information sharing, which is key as part of the performance measurements as well. Establishing a reporting mechanism that is transparent to all stakeholders engaged in the A-CDM procedures is critical to its success.

It is recommended that, as part of the implementation project, a reporting mechanism is set and agreed upon with all stakeholders. Which Key Performance Indicators shall be commonly shared and how shall they be shared, e.g. monthly by e-mail in Excel or real-time via a dashboard, is important. Nevertheless, with the use of information technology, these KPIs can be disseminated easily to all stakeholders at real-time. Equally important is to agree on who holds the responsibility to produce and disseminate the information.

In principle, sharing more information is better than sharing less as it improves cooperation among stakeholders and improves the overall A-CDM process, hence enhancing the possibility to reach objective.

A good communication platform coupled with data analysis helps to provide a means for all stakeholders to review and refine operations to improve KPIs.

4 Examples of Performance Objectives and Indicators

A-CDM is implemented at over 30 airports worldwide and more are in the process of doing so. There is already considerable documentation available that relates to measurement of A-CDM performance benefits. The purpose of this chapter is to inform ANSPs in particular of the benefits that can be expected that directly or indirectly have an impact on the ANSP's business. Therefore, this section of the document lists recommended Key Performance Objectives and outlines associated Key Performance Indicators etc. that have either a direct or indirect impact on ANSPs. This is based on the principles of the Performance Framework, and shows how ANSPs can draw value from A-CDM, including the work required.

4.1 Key Performance Area – Efficiency

4.1.1 Key Performance Objective: Optimise the Runway Throughput

KPI Name	Runway Throughput Optimisation
Purpose/Value	This KPI helps stakeholders to assess if the introduction of A-CDM procedures can optimise runway (RWY) throughput by comparing declared departure (DEP) capacity against real departure (DEP) rate.
ANSP Impact	Direct
Expected Result	The expected outcome from this KPI is: 1. The actual DEP rate should be equal or higher than declared capacity 2. The actual DEP rate should be equal to actual demand
Data Requirement	• Declared DEP RWY capacity per time interval (e.g. per hour) Actual DEP RWY rate per time interval (e.g. per hour)
Formula	Declared DEP RWY capacity – Actual DEP rate
KPI Format	Can be an absolute value or percentage over a defined time period
Tips/Warning	If actual demand is lower than the declared rate, the performance measurement needs to be based on the actual demand rather than the declared rate. The actual demand needs to be determined by the TOBT and TTOT per time interval.
System Requirements	TBD based on implementation

4.1.2 Key Performance Objective: Optimise the take off and departure queue by using Pre-Departure Sequencing (PDS) incl. Variable Taxi Times

KPI Name	Target start-up approval time (TSAT), target take-off time (TTOT), and estimated taxi-out time (EXOT) Accuracy
Purpose/Value	This KPI assists stakeholders to optimise the Pre-Departure Sequence and the departure queue
ANSP Impact	Direct
Expected result	Smaller deviations indicate the preferred result.
Data requirement	• TSAT • Actual start-up approval time (ASAT) (or alternatively actual block-off time (AOBT), if AOBT cannot be obtained) • EXOT • Actual taxi-out time (AXOT) • TTOT • Actual take-off time (ATOT)
Formula	• TSAT to ASAT (or alternatively AOBT, if AOBT cannot be obtained) • AXOT to EXOT • TTOT to ATOT
KPI Format	Absolute value in HH:MM.SS
Tips/Warning	To measure this, a reference point needs to be determined for the measurement of TSAT, EXOT and TTOT. For example, this can be done at Milestone 10, 'Issue of TSAT' as this is the point when an accurate TSAT is expected.
System requirements	TBD based on implementation

4.1.3 Key Performance Objective: Increase Compliance to ATFM slots (Example 1)

KPI Name	Aircraft in queue (at runway holding point)
Purpose/Value	This KPI helps stakeholders assess if the number of aircraft in the departure queue is less with A-CDM procedures, including PDS.
ANSP Impact	Direct
Expected Result	The expected result is that the number of aircraft queueing at holding points should be lower.
Data requirement	Number of aircraft in queue over a given time interval (e.g. one hour)
Formula	Number of aircraft A/C in queue over a given time interval minus Number of aircraft in queue over a given time interval
KPI Format	Absolute number and/or percentage
Tips/Warning	This KPI has to be compared to a baseline established before A-CDM.
System requirements	TBD based on implementation

4.1.4 Key Performance Objective: Increase Compliance to ATFM slots (Example 2)

KPI Name	Air traffic flow management (ATFM) slot compliance
Purpose/Value	This KPI will assist stakeholders to assess the compliance with ATFM imposed calculated take off time (CTOT) regulations. This will potentially help identify trends of non-compliance that can lead to improvements of departure procedures and PDS enhancements.
ANSP Impact	Direct
Expected result	Ideally this number should be zero
Data requirement	Number of departures with CTOT assigned Number of actual departure outside of CTOT window
Formula	Compare number of departures (DEP) outside assigned CTOT window to total number of DEP with CTOT.
KPI Format	Absolute number and/or percentage value over a given time interval
Tips/Warning	In ideal cases this should not occur as a new CTOT should be assigned to the aircraft based on the TOBT/TSAT information in a fully A-CDM-ATFM integrated environment, assuming the ATFM solution takes A-CDM information into account.
System requirements	TBD based on implementation

4.2 Key Performance Area – Workload

4.2.1 Key Performance Objective: Reduce ATCO Transmission Workload (Example 1)

KPI Name	Radio Transmissions By Clearance Delivery Controller (CDC) and/or by Ground Controller (GC)
Purpose/Value	This KPI helps assess if the there is a change in workload for Clearance Delivery Controller and/or by Ground Controller (GC) with A-CDM procedures in-place
ANSP Impact	Direct
Expected result	Over time the workload should be reduced as ATCOs get more accustom to the A-CDM procedures and information presented to them.
Data requirement	• No of radio transmissions (RT) • Duration of RT
Formula	• No of RT for a given time interval • Duration of RT
KPI Format	Absolute value for a given time interval
Tips/Warning	For this KPI to be accurately measured, RT transmissions during current operations have to be measured and benchmarked. It is very important the A-CDM procedures are implemented with this KPI in mind, e.g. the start-up and push-back procedures. Dependent on the procedures implemented with A-CDM, this KPI might also impose more radio transmissions initially. It is also dependent on, for example, implementation of Data Link Clearances and integration with A-CDM procedures.
System requirements	TBD based on implementation

4.2.1 Key Performance Objective: Reduce ATCO Transmission Workload (Example 2)

KPI Name	Manual tool intervention by Clearance Delivery Controller (CDC) and/or Ground Controller (GC)
Purpose/Value	This KPI helps assess if there can be a reduction in the workload for the Clearance Delivery Controller (CDC) and/or by Ground Controller (GC)
ANSP Impact	Direct
Expected result	With a high level of automation and information integration into current air traffic control (ATC) tools, the result should indicate less need for manual interventions.
Data requirement	Measurement of the need for manual tool interventions.
Formula	Tool interventions before A-CDM compared to tool interventions after A-CDM.
KPI Format	
Tips/Warning	This is a complex KPI to measure as it will require tools that can measure actual tool interventions or manual observations to take place to allow it to be based on data. This will also have to be done prior and after A-CDM is implemented. Another approach is to allow for analysis based on ATCO interviews and assessment of the perceived workload from tool interventions.
System requirements	TBD based on implementation

4.3 Key Performance Area – Capacity

4.3.1 Key Performance Objective: Increase Stands utilisation (Example 1)

KPI Name	Average Aircraft Turn Around Time
Purpose/Value	This KPI helps stakeholders in assessing if the average aircraft turnaround time has been impacted with the A-CDM procedures. With the implementation of A-CDM, the wasted time and scheduling for ground handlers (inclusive of refuelling, etc.) should improve, leading to a reduction in aircraft turn-around time. If turn-around time can be reduced, stands utilisation or capacity could in turn increases.
ANSP Impact	Indirect
Expected Result	Should be maintained within pre-defined range based of aircraft type
Data requirement	Minimum turn-around time (MTTT), actual turn-around time (ATTT), historical average actual turn-around time (ATTT), actual in-block time (AIBT), actual block-off time (AOBT)
Formula	AOBT – AIBT
KPI Format	Duration in minutes
Tips/Warning	Different aircraft type and configuration may impact the MTTT
System requirements	TBD based on implementation

4.3.2 Key Performance Objective: Increase Stands Utilisation (Example 2)

KPI Name	Stand Conflict Hit Rate
Purpose/Value	This KPI helps stakeholders assess if the number of stand conflicts have reduced with A-CDM procedures. The expected result should be lower than non-A-CDM practice. The occurrences of gate conflicts should drop given the accuracy, update and availability of information such as estimated off-block time (EOBT), estimated in-block time (EIBT), etc. This information enables airport operators to determine potential stand conflict earlier to perform stand re-allocation.
ANSP Impact	Indirect
Expected Result	Ideally should be zero
Data requirement	AIBT, actual departure time (ALDT), AOBT
Formula	ALDT + variable taxi times (VTT) (incoming flight) > AOBT (outgoing flight)
KPI Format	No. of occurrence (integer number)
Tips/Warning	This KPI will indirectly determine the congestion level in the tarmac.
System requirements	TBD based on implementation

4.4 Key Performance Area – Environment

4.4.1 Key Performance Objective: Reduce Carbon Footprint

KPI Name	Taxi Time
Purpose/Value	This KPI helps stakeholders assess if the average aircraft taxi time has reduced with A-CDM procedures. With the implementation of PDS, the taxi waiting time (departure flight) should decrease.
ANSP Impact	Indirect
Expected Result	The expected result should be lower than non-A-CDM practice
Data requirement	ATOT, AOBT
Formula	ATOT – AOBT
KPI Format	MM:SS
Tips/Warning	This KPI will indirectly determine the congestion level in the tarmac.
System requirements	TBD based on implementation

5 Acronyms

A/C	Aircraft
A-CDM	Airport Collaborative Decision Making
AIBT	Actual in-block time
ALDT	Actual departure time
ANSP	Air Navigation Service Providers
AOBT	Actual block-off time
ASAT	Actual start-up approval time
ATCO	Air traffic control officer
ATFM	Air Traffic Flow Management
ATOT	Actual take-off time
ATTT	Actual turn-around time
AXOT	Actual taxi-out time
CANSO	Civil Air Navigation Services Organisation (CANSO)
CDC	Clearance Delivery Controller
CTOT	Calculated Take-Off Time
DEP	Departure
EIBT	Estimated in-block time
EOBT	Estimated off-block time
EXOT	Estimated taxi-out time
GC	Ground Controller
KPA	Key Performance Area
KPI	Key Performance Indicator
MTTT	Minimum turn-around time
PDS	Pre-Departure Sequencer
RT	Radio transmission
RWY	Runway
TBD	To be determined
TOBT	Target-Off Block Time
TSAT	Target Start-up Approval Time
TTOT	Target Take-Off Time
VTT	Variable Taxi Times

The list above is a list of acronyms found in this publication only. Many more A-CDM related acronyms exist and can be found in various publications.