International Civil Aviation Organization

Eleventh Meeting of the Air Traffic Management Sub-Group (ATM/SG/11) of APANPIRG

Singapore, 2 – 6 October 2023

Agenda Item 3: Performance Frameworks and Metrics

FORMATION OF DATA ANALYTICS GROUP TO ESTABLISH ATM PERFORMANCE MANAGEMENT IN APAC

(Co-presented by China, Indonesia, Japan, Malaysia, Singapore, Thailand, United States)

SUMMARY

This paper proposes to form a Data Analytics Group (DAG) under the ambit of the ATM/SG. At the APANPIRG/33, an informal group consisting of China, Indonesia, Japan, Malaysia, Singapore, Thailand, and the United States was formed and conducted trial activities on performance management on 8 ICAO GANP KPIs. The group confirmed that several states in the region are ready for performance measurement, and the group proposes for the formation of a DAG to continue building on this foundation to establish a broader reporting capability across the region that each state can contribute to according to their own capabilities. This reporting capability could then be used to help prioritise and monitor progress of APANPIRG initiatives using the guidance in ICAO Doc. 9883.

1. INTRODUCTION

1.1 The Global ATM Operational Concept (Doc 9854) envisaged a performance-based global air navigation system. Based on this, ICAO published the Manual on Air Traffic Management System Requirements (Doc 9882) and the Manual on Global Performance of the Air Navigation System (Doc 9883). To complement the guidance in Doc 9883 on performance-based approach (PBA) to ATM, the Global Air Navigation Plan (GANP, Doc 9750) included a segment on key performance indicators (KPIs). These were developed for consideration by States to facilitate the PBA.

1.2 Using PBA in the prioritisation and implementation of ATM initiatives provides States/Administrations a data-driven and scientific approach to achieve their performance objectives. To advance the adoption of PBA in the Asia Pacific (APAC) Region, the Regional ATM Performance Measurement Framework Small Working Group (RAPMF/SWG) was established at the third meeting of the ATM Subgroup (ATM/SG/3) to develop the APAC Air Traffic Management Performance Measurement Framework (ATM/PMF). In 2019, the 30th meeting of the Asia Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) endorsed the ATM/PMF. The ATM/PMF provides the stages of implementation for KPIs identified under the KPAs in the GANP and prescribes a step-by-step performance-based approach to ensure that the region will develop data and performance management capabilities in a harmonized manner.

1.3 At APANPIRG/30, APAC States/Administrations were urged to consider the ATM/PMF and initiate their own performance measurement practice, including the implementation of the eight Stage 1 KPIs listed in the ATM/PMF to support the achievement of the Seamless ATM and regional ATFM goals in the APAC region. At the 41st meeting of the ICAO Assembly, the Technical Commission also urged States/Administrations and PIRGs to establish a performance-based management approach and define performance targets according to their needs.

1.4 At APANPIRG/33, ICAO proposed that Singapore and other proponent states form an informal collaborative group to develop the proposal for the formation of the SWG at ATM/SG. An informal group consisting of China, Indonesia, Japan, Malaysia, Singapore, Thailand, and the United States was formed to conduct trial activities on performance management and the group proposes to form a Data Analytics Group (DAG).

2. DISCUSSION

Informal Group

2.1 The informal group ("group") held its first meeting on 30th January 2023. Over 6 meetings, the group had conducted activities to inform the formation of the DAG under the ambit of the ATM/SG. In doing so, this group considered the ATM/PMF that was developed by RAPMF/SWG. Since then, the group has

- selected a set of initial ATM KPIs and associated KPAs that were then aligned with ICAO GANP definitions and agreed upon as important for understanding group members' readiness for harmonised and regular reporting;
- conducted a survey with the group's members on current performance management activities;
- conducted trial performance measurement;
- developed data collection process; and
- proposed the terms of reference and task list for the DAG.

Initial ATM KPIs

2.2 The group selected the following ICAO GANP KPIs to examine its members' readiness for harmonized and regular reporting: Airport Peak Capacity (KPI09), Airport Peak Throughput (KPI10), Additional Taxi-out Time (KPI02), Additional Taxi-in Time (KPI13), Departure Punctuality (KPI01), Arrival Punctuality (KPI14), and Additional Fuel Burn (KPI16). Definitions and additional details on each of these KPIs can be found in Appendix B.

Performance Management Survey

2.3 The results of the performance management survey showed that the group's members were ready to measure and track the eight Phase 1 KPIs as identified in the ATM/PMF for their major airports. These KPIs were used as part of national ATM performance frameworks for ATM planning and the improvement of ATM performance. In addition to the Phase 1 KPIs, the group considered the inclusion of ICAO GANP KPI16 on Additional Fuel Burn to measure the impact of sustainability efforts. Table 1 presents a summary of the survey results.

Survey Questions		**Survey Results Summary**
What KPIs are measured?	KPI09 – Airport Peak Capacity	All 7 states measure these KPIs
	KPI10 – Airport Peak Throughput	
	KPI02 – Additional Taxi-out Time	
	KPI13 – Additional Taxi-in Time	
	KPI01 – Departure Punctuality	
	KPI14 – Arrival Punctuality	
	KPI16 – Additional Fuel Burn	2 out of 7 states measure this KPI
What airports are the KPIs measured at?		All major airports are included
Earliest year where all data sets are available?		Varies but all states have data from 2019 onwards
Is there a National ATM Performance Framework?		Yes, in all 7 states
Are KPIs used to improve ATM performance?		Yes, in all 7 states
Are KPIs used for ATM future planning?		Yes, in all 7 states

Table 1 – Survey results summary

Trial Performance Measurement Activity

2.4 Following the survey, the group proceeded with a trial activity to measure performance for a period of six months from Nov 2022 to Apr 2023. The group decided to only include KPI16 after the ICAO GANP Performance Expert Group (GANP-PEG) formalized the measurement methodology. For countries with many airports, only the major airports by traffic count were included. As the ICAO GANP has included KPI variants within its performance framework, the group had come to a consensus on suitable KPI variants as listed in Table 2.

KPA	**KPI**	**Variant**	**GANP KPI Code**
Capacity	Airport peak capacity	Departure	KPI09-D
		Arrival	KPI09-A
		Total	KPI09-AD
Capacity	Airport peak throughput	Departure	KPI10-1D
		Arrival	KPI10-1A
		Total	KPI10-1AD
Efficiency	Additional taxi-out time	Advanced	KPI02-2
Efficiency	Additional taxi-in time	Advanced	KPI13-2
Predictability	Departure punctuality	± 15 mins	KPI01-2A
Predictability	Arrival punctuality	± 15 mins	KPI14-2A

Table 2 – Trial performance measurement activity KPI variants

2.5 Analysis of the data collected by the group provided insights to ATM performance. Figure 1 shows airport departure capacities and peak departure throughputs. It was observed that several airports were operating close to their peak departure capacities. For these airports, it is very difficult, if at all possible, to accommodate sudden surges in demand; therefore, such locations are likely candidates for application of ATM measures to help with smoothing traffic flows and with preventing excessive delays and congestion in their terminal areas or on the surface. Diving deeper, Figure 2 illustrates the commendable efforts in stretching capacity to meet demand. For WMKK, the data showed the ability to accommodate demand above capacity. In the case of KEWR, the data shows an increase in departure capacity and in flights accommodated in the peak hour. These increases in peak departure throughputs above capacity and the increase in departure capacity can be further assessed to see if this was a response to airline schedule peaks, more favourable weather conditions, or changes in procedures that allow for greater departure throughput. These learnings will prove to be useful to APAC members as demand in the region steadily recovers to pre-COVID levels and beyond, enabling all members to

improve ATM performance to effectively serve rising demand and manage capacity-demand imbalances.

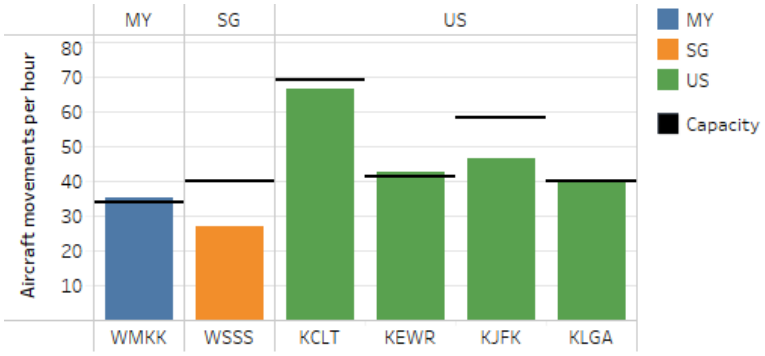


Figure 1 – Departure capacities and peak departure throughputs

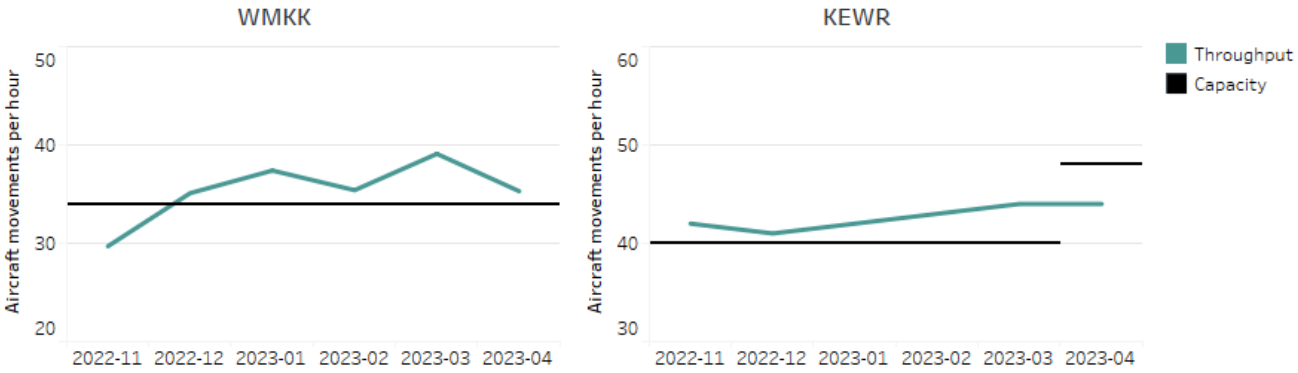
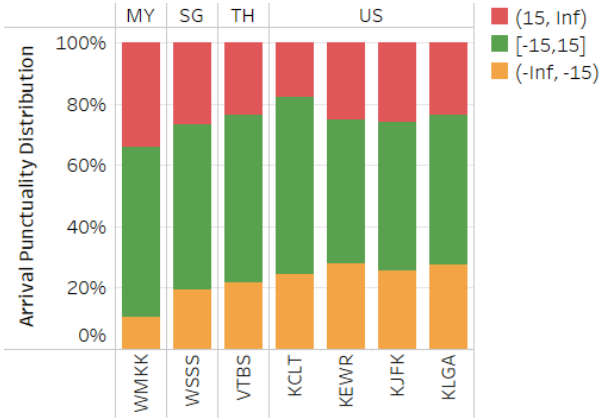


Figure 2 – Departure capacities and departure throughputs by month for selected airports operating at or near capacity

2.6 Figure 3 shows the arrival punctuality distribution. Considering arrival punctuality data (KPI14-2A), it was observed that early arrivals contributed to more than 20% of its arrivals in the United States and Thailand. This may suggest that a larger buffer was built into schedules by the aviation ecosystem in these states. On the other hand, a high proportion of flights with delays greater than 15 minutes may indicate the need for expansion of available ATM measures to help manage capacity-to-demand imbalances more efficiently. Such observation offers a good starting point to analyse the buffers built into the ATM system to identify areas where greater efficiency can be realized.



* Note: Data for VTBS is for the year 2022

Figure 3 – Range of arrival punctuality across airports

Proposed Formation of ATM/SG Data Analytics Group

2.7 During the trial, the group had made significant advances in enabling data collection, evaluation, and reporting. While the abilities across members vary, results from the analyses of the data demonstrated the usefulness and potential of ATM performance measurement; representing a first step towards using data to improve ATM performance in the region. Some of these results and potential next steps were shared in the previous section of this working paper.

2.8 Throughout the trial activity, group members found discussions regarding the KPI calculation methodologies and best means of data exchange useful. Having harmonized data processing methodologies, and procedures for data exchange will allow better understanding of the state of ATM performance in APAC. The informal group confirmed that several member States are ready to initiate performance measurement, and the group proposes to continue building on this foundation to establish a broader reporting capability across the region that each State can contribute to according to their own capabilities while the other States continue working on improving our data collection systems and capabilities. Recognising that levelling up the region in terms of data analytics is crucial to enabling the full use of reported performance metrics, this paper proposes that a Data Analytics Group (DAG) be formed under the ambit of the ATM/SG to advance this area of work.

2.9 The draft terms of reference and the list of tasks for the proposed DAG is included in Appendix A. In addition, the group produced a data collection guide to harmonize the methodologies with the group's preferred ICAO GANP KPI variant. These documents are included in the Appendix for the DAG's further development when it is formed.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) discuss the importance of adopting performance-based approach for the region; and

c) agree to the formation of a data analytics group (DAG).

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<table>
<tr><td colspan="3">Draft Conclusion/Decision ATM/SG/11-X: ESTABLISH PERFORMANCE MANAGEMENT DATA ANALYTICS GROUP</td></tr>
<tr><td colspan="2">That, ATM/SG establishes the Performance Management Data Analytics Group, that will:

a) Identify initial ATM KPIs, data requirements and common data analysis and evaluation methodologies for APANPIRG.
b) Assess participating States' / Administrations' ability to evaluate and report ATM KPIs and propose phases of adoption.
c) Validate ATM KPIs, data requirements and common evaluation methodologies through a trial evaluation and reporting by participating States / Administrations.
d) Propose framework for reporting of ATM KPIs, including frequency and mechanism.
e) Study insights provided by State /Administration reports and propose additional KPIs and/or modifications to existing KPIs to expand understanding of opportunities to improve ATM performance in APAC region.</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: Identify and harmonize data analysis capabilities across the APAC region and identify KPIs suitable for assessment of ATM performance in the region to advance the adoption of Performance Based Approach (PBA) in the APAC Region.</td><td colspan="2">Follow-up: ☐Required from States</td></tr>
<tr><td>When: 23-Oct-23</td><td colspan="2">Status: Draft to be adopted by Subgroup</td></tr>
<tr><td colspan="3">Who: ☒Sub groups ☐APAC States ☐ICAO APAC RO ☐ICAO HQ ☐Other:</td></tr>
</table>

APPENDICES

APPENDIX A – TERMS OF REFERENCE AND TASK LIST FOR ATM/SG DAG

APPENDIX B – DATA COLLECTION GUIDE

APPENDIX A – TERMS OF REFERENCE AND TASK LIST FOR ATM/SG DAG

TERMS OF REFERENCE FOR ATM/SG DATA ANALYTICS GROUP (DAG)

Background

The Global ATM Operational Concept (Doc 9854) envisaged a performance-based global air navigation system. Based on this, ICAO published the Manual on Air Traffic Management System Requirements (Doc 9882) and the Manual on Global Performance of the Air Navigation System (Doc 9883). To complement the guidance in Doc 9883 on performance-based approach (PBA) to ATM, the Global Air Navigation Plan (GANP, Doc 9750) included a segment on key performance indicators (KPIs). These were developed for consideration by States to facilitate the PBA.

Using PBA in the prioritization and implementation of ATM initiatives provides States/Administrations and organizations a data-driven and scientific method to achieve their performance objectives. To advance the adoption of PBA in the Asia Pacific (APAC) Region, the Regional ATM Performance Measurement Framework Small Working Group (RAPMF/SWG) was established at the third meeting of the ATM Subgroup (ATM/SG/3) to develop the APAC Air Traffic Management Performance Measurement Framework (ATM/PMF). In 2019, the 30th meeting of the Asia Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) endorsed the ATM/PMF. The ATM/PMF provides the stages of implementation for KPIs identified under the KPAs in the GANP and prescribes a step-by-step performance-based approach to ensure that the region will develop data and performance management capabilities in a harmonized manner.

At APANPIRG/30, APAC States/Administrations were urged to consider the ATM/PMF and initiate their own performance measurement practice, including the trial implementation of the eight Stage 1 KPIs listed in the ATM/PMF to support the achievement of the Seamless ATM and regional ATFM goals in the APAC region. At the 41st meeting of the ICAO Assembly, the Technical Commission also urged States/Administrations and PIRGs to establish a performance-based management approach and define performance targets according to their needs. At APANPIRG/33, a small working group was proposed to be established at ATM-SG/11 to identify Key Performance Indicators (KPIs) to be measured and studied, and to develop a proposal to track regional KPIs.

Objective

Establish a framework for evaluation of ATM performance that enables consistent reporting across APAC States/Administrations.

Scope

Through a phased approach and information exchange between the States/Administrations, identify data and analytical capabilities across the APAC region, and KPIs suitable for assessment of ATM performance in the region. Propose a reporting framework consisting of common ATM KPIs, data requirements and evaluation methodologies for their assessment.

Required Expertise

Performance management experts and ATM operations experts from States/Administrations, international organizations, ANSPs, airspace users and airport operators in the APAC region. These members will provide subject matter expertise related to the different KPIs and contextual information, as well as on operations research, data science, statistics, or data / technological matters.

Tasks

Task 1: Identify initial ATM KPIs, data requirements and common data analysis and evaluation methodologies for APANPIRG.

Task 2: Assess participating States' / Administrations' ability to evaluate and report ATM KPIs and propose phases of adoption.

Task 3: Validate ATM KPIs, data requirements and common evaluation methodologies through a trial evaluation and reporting by participating States / Administrations.

Task 4: Propose framework for reporting of ATM KPIs, including frequency and mechanism.

Task 5: Study insights provided by State /Administration reports and propose additional KPIs and/or modifications to existing KPIs to expand understanding of opportunities to improve ATM performance in APAC region.

APPENDIX B – DATA COLLECTION GUIDE

1. INTRODUCTION

This document contains the definitions and calculation methodologies to be used for the Data Analytics Group's (DAG's) performance management and data collection purposes. The data gathered will be studied and used to provide insights and illustrate the benefits of performance management.

2. PROTECTION AND USE OF DATA

a) All data provided and used shall be protected against public disclosure.
b) Data provided should only be used for the purposes of the DAG's work as guided by the DAG's Terms of Reference and Task List.
c) Written permission from the data provider shall be sought for the use of data for any purpose not provided for in (b).
d) Data quality and validation is the responsibility of the data provider.

3. GENERAL NOTES

The KPIs are based on GANP KPIs and organized by the GANP Performance Objectives. Deviations from GANP definitions are italicized (if applicable). Only KPI variants considered by the DAG will have their definitions listed here. KPI variants will be identified by suffixing the main KPI identifier. For example, Variant 2A of KPI01 will be referred to as KPI01-2A. Data will be collected at a resolution of once a month. Cut-offs will be determined by Actual Take-off Time (ATOT) and Actual Landing Time (ALDT) in UTC.

For calculation of unimpeded or reference times, a full year of data from 2019 shall be utilized, unless otherwise specified.

4. PREDICTABILITY

For the predictability performance objective, the informal group will be collecting data to calculate variants 2A and 2B of the KPIs, i.e. KPI01-2A, KPI01-2B, KPI14-2A, KPI14-2B.

4.1 DEFINITIONS

KPI Name	Departure Punctuality (KPI01)
Definition	Percentage of flights departing from the gate on-time (compared to schedule).
Measurement	% of scheduled flights
Variants	Variant 2A – % of departures delayed within ± 15 mins of scheduled time of departure Variant 2B – % of departures delayed <= 15 mins versus schedule
Parameters	On-time threshold (maximum positive or negative deviation from scheduled departure time) which defines whether a flight is counted as on-time or not. Recommended values: 5 minutes and 15 minutes.
Data Requirement	For each departing scheduled flight: • Scheduled time of departure (STD) • Actual off-block time (AOBT)
Formula	At the level of individual flights: • Exclude non-scheduled departures

	• Categorize each scheduled departure as on-time or not At aggregated level: • Compute the KPI: number of on-time departures divided by total number of scheduled departures

Table 1 – Departure punctuality definition

KPI Name	Arrival Punctuality (KPI14)
Definition	Percentage of flights arriving at the gate on-time (compared to schedule).
Measurement	% of scheduled flights
Variants	Variant 2A – % of arrivals delayed within ± 15 mins of scheduled time of arrival Variant 2B – % of arrivals delayed <= 15 mins versus schedule
Parameters	On-time threshold (maximum positive or negative deviation from scheduled arrival time) which defines whether a flight is counted as on-time or not. Recommended values: 5 minutes and 15 minutes.
Data Requirement	For each arriving scheduled flight: • Scheduled time of arrival (STA) • Actual in-block time (AIBT)
Formula	At the level of individual flights: • Exclude non-scheduled arrivals • Categorize each scheduled departure as on-time or not At aggregated level: • Compute the KPI: number of on-time departures divided by total number of scheduled departures

Table 2 – Arrival punctuality definition

4.2 DATA COLLECTION

To calculate the predictability KPIs, we would require the breakdown of flights by Arrival, Departure, and time buckets. There will be three time buckets and $x = \text{Actual} - \text{Scheduled}$ for the below definitions:

- (-INF, -15) Flights arriving or departing when $x < -15$ minutes.
- [-15,15] Flights arriving or departing when $-15 \leq x \leq 15$ minutes.
- (15, INF) Flights arriving or departing when $x > 15$ minutes.

Table 3 shows a sample of the data collection template with dummy data for illustration.

Airport	Date	Phase	No. of Flights	(-INF, -15)	[-15,15]	(15, INF)
ZZZZ	2022-11	DEP	12,345	190	8,386	3,769
ZZZZ	2022-12	DEP	12,346	114	8,064	4,168
ZZZZ	2023-01	DEP	12,347	137	8,886	3,324
ZZZZ	2022-11	ARR	12,348	2,203	6,887	3,258
ZZZZ	2022-12	ARR	12,349	2,038	6,237	4,074
ZZZZ	2023-01	ARR	12,350	2,347	6,619	3,384

Table 3: Data collection template for predictability with dummy data

4.3 CALCULATION METHODOLOGY

For departures,

1. Exclude non-scheduled flights and cancelled flights.
2. Calculate the time difference AOBT − STD.
3. Categorize each flight into the 3 buckets of (-INF, -15), [-15,15], (15, INF).
4. Sum up the number of flights in each bucket for every month.

For arrivals,

1. Exclude non-scheduled flights and cancelled flights.
2. Calculate the time difference AIBT − STA.
3. Categorize each flight into the 3 buckets of (-INF, -15), [-15,15], (15, INF).
4. Sum up the number of flights in each bucket for every month.

5. EFFICIENCY

For the predictability performance objective, the informal group will be collecting data to calculate both the basic and advanced variants of the KPIs. i.e. KPI02-1, KPI02-2, KPI13-1, KPI13-2.

5.1 DEFINITIONS

KPI Name	**Additional taxi-out time (KPI02)**
Definition	Actual taxi-out time compared to an unimpeded/reference taxi-out time.
Measurement	Minutes/flight
Variants	Variant 1 – Basic (computed without departure gate and runway data) Variant 2 – Advanced (computed with departure gate and runway data)
Parameters	Unimpeded/reference taxi-out time: • Recommended approach for the basic variant of the KPI: A single value at airport level, e.g. the 20th percentile of actual taxi times recorded at an airport, sorted from the shortest to the longest. *[For basic variant, reporting can be done at runway level if data is available]* • Recommended approach for the advanced variant of the KPI: A separate value for each runway/gate combination, e.g. the average actual taxi-out time recorded during periods of non-congestion (needs to be periodically reassessed). *[For advanced variant, the reference taxi-out time will be set at 20th percentile of actual taxi times recorded. To prevent issues with low sample sizes, data may be reported at runway and gate cluster level instead of at the individual gate level.]*
Data Requirement	For each departing flight: • Actual off-block time (AOBT) • Actual take-off time (ATOT) In addition, for the advanced variant: • Departure gate ID • Take-off runway ID
Formula	At the level of individual flights: 1. Select departing flights, exclude helicopters 2. Compute actual taxi-out duration: ATOT minus AOBT 3. Compute additional taxi-out time: actual taxi-out duration minus unimpeded taxi-out time At aggregated level:

	4. Compute the KPI: sum of additional taxi-out times divided by number of IFR departures

Table 4 – Additional taxi-out time definition

KPI Name	Additional taxi-in time (KPI13)
Definition	Actual taxi-in time compared to an unimpeded/reference taxi-in time.
Measurement	Minutes/flight
Variants	Variant 1 – Basic (computed without landing runway and arrival gate data) Variant 2 – Advanced (computed with landing runway and arrival gate data)
Parameters	Unimpeded/reference taxi-in time: • Recommended approach for the basic variant of the KPI: A single value at airport level, e.g. the 20th percentile of actual taxi times recorded at an airport, sorted from the shortest to the longest. *[For basic variant, reporting can be done at runway level if data is available]* • Recommended approach for the advanced variant of the KPI: A separate value for each runway/gate combination, e.g. the average actual taxi-out time recorded during periods of non-congestion (needs to be periodically reassessed). *[For advanced variant, the reference taxi-out time will be set at 20th percentile of actual taxi times recorded. To prevent issues with low sample sizes, data may be reported at runway and gate cluster level instead of at the individual gate level.]*
Data Requirement	For each arriving flight: • Actual in-block time (AIBT) • Actual landing time (ALDT) In addition, for the advanced variant: • Arrival gate ID • Landing runway ID
Formula	At the level of individual flights: 1. Select arriving flights, exclude helicopters 2. Compute actual taxi-in duration: AIBT minus ALDT 3. Compute additional taxi-in time: actual taxi-in duration minus unimpeded taxi-in time At aggregated level: 4. Compute the KPI: sum of additional taxi-in times divided by number of IFR arrivals

Table 5 – Additional taxi-in time definition

5.2 DATA COLLECTION

The Efficiency KPIs will be collected with the following data collection template.

Airport	Date	KPI02-1	KPI02-2	KPI13-1	KPI13-2
ZZZZ	2022-11	10.03	4.85	2.07	1.75
ZZZZ	2022-12	11.71	5.27	2.34	1.83
ZZZZ	2023-01	11.89	5.32	2.40	1.90

Table 6 – Data collection template for efficiency with dummy data

5.3 CALCULATION METHODOLOGY

Reference Time

1. Only include IFR flights.
2. Calculate actual taxi-out or taxi-in times for each flight: ATOT − AOBT or AIBT − ALDT respectively.
3. Group flights by runway and gate / gate clusters.
4. For each group, obtain the 20th percentile taxi-out or taxi-in time as the runway and gate / gate cluster combination's reference time.

Additional Taxi Time

1. Only include IFR flights.
2. Calculate actual taxi-out or taxi-in times for each flight: ATOT − AOBT or AIBT − ALDT respectively.
3. Group flights by runway and gate / gate clusters.
4. For each group, subtract the reference time from the actual times to obtain the additional taxi-out or taxi-in time, using a different reference time for each runway and gate / gate cluster combination.
5. Obtain the average additional taxi-out or taxi-in times for the month across all flights.

6. CAPACITY

For the capacity performance objective, the informal group will be collecting data to calculate all variants of KPI09, i.e. KPI09-A, KPI09-D, KPI09-AD. For KPI10, variant 1 on IFR operations will be calculated, i.e. KPI10-1A, KPI10-1D, KPI10-1AD

6.1 DEFINITIONS

KPI Name	Airport Peak Capacity (KPI09)
Definition	The highest number of operations an airport can accept in a one-hour time frame (also called declared capacity). Can be computed for arrivals, departures, or arrivals + departures.
Measurement	Number of departures / hour, Number of landings / hour, Number of (departures + landings) / hour
Variants	Variant A – Airport peak arrival capacity Variant D – Airport peak departure capacity Variant AD – Airport peak movement capacity (departures + arrivals)
Parameters	None
Data Requirement	Scheduling parameters for slot controlled airports Airport acceptance rates (AAR) Airport departure rates (ADR)
Formula	At the level of an individual airport: 1. Select highest value from the set of declared capacities 2. Compute the KPI: convert the value to an hourly rate, if the declaration is at smaller time intervals

Table 7 – Airport peak capacity definition

KPI Name	Airport Peak Throughout (KPI10)
Definition	The 95th percentile of the hourly number of operations recorded at an airport, in the "rolling" hours sorted from the least busy to the busiest hour. Can be computed for arrivals, departures, or arrivals + departures.
Measurement	Number of departures / hour, Number of landings / hour, Number of (departures + landings) / hour

Variants	Variant 1 – IFR operations only To be combined with: Variant A – Airport peak arrival capacity Variant D – Airport peak departure capacity Variant AD – Airport peak movement capacity (departures + arrivals)
Parameters	Time interval for "rolling" hours. Recommended value: 15 minutes The percentile chosen to exclude outliers. Recommended value: 95th percentile
Data Requirement	For each flight: Actual landing time (ALDT) Actual take-off time (ATOT)
Formula	At the level of an individual flights: 1. Select flights, exclude helicopters 2. Convert the set of landings to hourly landing / departure rates by "rolling" hour 3. Sort the "rolling" hours from the least busy to the busiest hour 4. Compute the KPI: it equals the landing rate value of the 95th percentile of the "rolling" hours

Table 8 – Airport peak throughput definition

6.2 DATA COLLECTION

Data will be collected for all variants of KPI09. For KPI10, data will be collected for KPI10-1A, KPI10-1D, and KPI10-1AD.

Airport	Date	KPI09-AD	KPI10-1AD	KPI09-A	KPI10-1A	KPI09-D	KPI10-1D
WSSS	2022-11	73	45	38	27	40	24
WSSS	2022-12	73	47	38	28	40	25
WSSS	2023-01	73	47	38	27	40	24

Table 9 – Data collection template for capacity with sample data

6.3 CALCULATION METHODOLOGY

This section will focus on KPI10 only as KPI09 consists of declared capacities.

Rolling Hours

The time interval for rolling hours will be set at 15 minutes. To illustrate rolling hours, consider the below example where we begin from 0900. Hourly peak throughputs will be calculated for the following time periods, where a new hourly period is considered every 15 minutes:

- 0900 – 1000
- 0915 – 1015
- 0930 – 1030

… and so on

Airport Peak Throughput

1. Restrict the hours considered to 0600 – 2259 local time for all airports.
2. For each month, calculate the number of flights per rolling hour for arrivals, departures, and arrivals + departures.
3. Arrange these rolling hours from the least number of flights to the greatest number of flights.
4. The 95th percentile rolling hour will be taken as the peak throughput