Regional Focus



Developing Key Performance Indicators for ANSPs – Improving Capacity, Efficiency and Punctuality in Asia Pacific

Tuesday 11 May 2021 04:00 – 06:00 UTC

Moderator



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Introduction to Performance Management and Available Resources

Speaker



John Gulding Senior Manager, ATO Office of Performance Analysis

FAA



The need for a Performance Capability

Getting to know your audience. Developing good communication materials.

ICAO Guidance and examples from FAA.

The need for a Performance Capability

Performance numbers drive the decisions Safety, Economic, Operational

Guides management investment

Leadership Question	Key Performance Indicator
Where/When is the system busy?	Operation Counts
Where/When is the system constrained?	Delay Numbers
How should the ANSP manage traffic?	Capacity Values

The Audience

Stakeholder/Airlines



Delays, Cancellations, Disruptive Events

ANSP Leadership



Cost, Operations, Capacity

The Regulator



Passenger Experience, On-Time Performance

FAA Performance Briefs to Leadership

FAA Daily System Reviews Report out on Delays Disruptive events (weather, construction, equipment)

Weekly Reviews Airline Schedule Analysis Brief

Monthly/Quarterly Progress on yearly targets

FAA Performance Briefs to Stakeholders

Daily System Reviews

Report out on Delays and events (weather, construction, equipment)

National Customer Forum (2nd Wednesday every Month) Strategic look at last month or last season Anticipated Constraints (construction, equipment), Seasonal Demand

IFR Flight Counts and Passenger Screenings



IFR Flight vs Delays and Traffic Restrictions



Major Airport Flight Counts, April 2021 vs CY17-19



Baseline limited to April 2017, April 2018, and April 2019. Size of circle is relative to latest traffic counts. Honolulu, HI (HNL) depicted on bar graph only. Source: ASPM

Traffic Projections for June, 2021



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Key Performance Metrics for April 2021 vs CY17-19

	Core30	NY3	ORD	MDW	DEN
ASPM Operations	-26 %	-52%	-36%	-32%	-7%
Completion Rate	0.6 pts	1.16 pts	1.18 pts	1.60 pts	0.07 pts
Diversions	-52%	-81%	-75%	-78%	-4%
ASPM Delays	-46%	-74%	-66%	-42%	-9%
Airborne Holding	-56%	-90%	-56%	-88%	17%
Distance Within 40NM	-2.0%	-7.8%	-2.0%	-0.3%	-0.1%
TS/IMC Hours	-33.0%	-40%	-60%	-52%	-1%
Snow Hours	-37%	-57%	-88%	-74%	37%

KPIs Recommended for Asia/Pacific

ASIA-PACIFIC AIR TRAFFIC MANAGEMENT PERFORMANCE MEASUREMENT FRAMEWORK - Version 1, November 2019 Detailed Definitions of KPIs, with 10 recommend for Initial Implementation

31st Asia/Pacific Air Navigation Planning and Implementation Regional Group – December 2020 Recommended 8 of the 10 for Initial Implementation

Messaging on KPIs

Capacity What traffic levels can the system accommodate given conditions? Used to regulate the flow of traffic

Delay

Demand greater than Capacity Shows constraints in the System Delay can be for non-ATC causes

KPIs Recommended for Asia Pacific

Key Performance Indicator

Airport Peak Arrival Capacity

Airport Peak Departure Capacity

Airport Arrival Throughput

Airport Departure Throughput

Additional Taxi-In Time

Additional Taxi-Out Time

Flight Arrival Punctuality

Flight Departure Punctuality

Value to Stakeholder, Management, Regulators

Establish benchmark, helps regulate traffic

Can help establish capacity, shows workload

Delay Measure, Indicator of constraints Can help guide where to invest

Delay against and airline schedule time Indicator of Constraints Public measure for Airlines

FAA Capacity OIS Page - https://www.fly.faa.gov/ois/

EWR

NOTE: The data depicted in these tables are for estimating purposes only and do not necessarily reflect the current operational plan or current traffic balancing activities. All data is for informational purposes only.

					AAR		
	Arrival	Departure	VMC (2000/3)	LOW VMC	IMC	LOW IMC	Notes
	22L	22R	40	36	32	29	LIMC is Tower Visibility Dependent. (LIMC = 26-32)
	22L	22L	28	26	26	16	This is single Rwy Operation - rarely used.
	22R	22R	28	26	26	16	This is single Rwy Operation - rarely used.
\triangleleft	22L 11	22R	48	\sum			Not used during LVMC or IMC
	22L CIR 29	22R	38	36			Not used during LVMC or IMC
	22L CIR 29 SGL RY	29	28	26			Not used during LVMC or IMC
	04R CIR 29	04L	36	36			Not used during IMC or LIMC.
	04R	04L	40	38	36	29	LIMC is Tower Visibility Dependent (LIMC = 26-32)
	04R 11	04L	48	46			2.5NM FINAL/LAHSO
	04R (SGL OPS)	04R (SGL OPS)	28	26	26	16	This is single Rwy Operation - rarely used.
	04L (SGL OPS)	04L (SGL OPS)	28	26	26	16	This is single Rwy Operation - rarely used.



Airspace Capacity (ICAO GANP KPI06) Sector or Large Airspace Volume

FAA's Traffic Flow Management System (TFMS) calculates projected times across a **Flow Control Area (FCA)** boundaries and then assigns a **<u>delay</u>** or a controlled time so that flow through this area matches the **<u>capacity</u>**



Separate east coast and west coast traffic. Establish optimal traffic volumes for the area

Establishing <u>Capacity</u> by Assessing <u>Throughput</u>



Getting Started

Data Repository Ability to store data from Flight Plan System Controller logs Publically available data (airline times)

An Analytical group Produce performance reports for management Consistency/Quality of Data uses

Data – Sources, quality, and quantity

Speakers



Sugoon Fucharoen ATFM implementation team AEROTHAI



Siree Vatanavigkit Strategic Planning Manager (Engineering) Policy and Strategy Management Bureau AEROTHAI **Regional Focus**



Data – Sources, quality, and quantity

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Developing KPIs for ANSPs –

Improving Capacity, Efficiency and Punctuality in APAC

Presented by: AEROTHAI Siree Vatanavigkit Sugoon Fucharoen

Tuesday 11 May 2021 04:00 – 06:00 UTC

Topics



Determining Data sources

□ Case Study: Integrated FPL Data

Looking to the Future: Data Analytics

Scope your search

- What do I want to measure (Which KPI suits my purpose)?
- What is the definition of the KPI?
- What data is required?
- Which systems provide the data?
- Who provides the data?
- How complete is the data? (Quantity)
- How accurate is the data? (Quality)
- Does the data make sense?





Let's shop for KPIs:

https://www4.icao.int/ganpportal/ASBU/KPI

KP101	Departure punctuality
KPI02	Taxi-out additional time
KPI03	ATFM slot adherence
5	
KPI04	Filed flight plan en-route extension
KPI05	Actual en-route extension
KPI06	En-route airspace capacity
KP107	En-route ATFM delay
KPI08	Additional time in terminal airspace
KPI09	Airport peak capacity
KPI10	Airport peak throughput



APAC ATM Performance Management Framework V 1.0 November 2019

S/N

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KPI Airport peak arrival capacity	KPA Capacity	GANP KPI09
Airport peak departure capacity	Capacity	KPI09
Airport arrival	Capacity	KPI10
Airport departure throughput	Capacity	KPI10
Additional taxi-in time	Efficiency	KPI13
Additional taxi- out time	Efficiency	KPI02
Flight arrival punctuality	Predictability	KPI14
Flight departure punctuality	Predictability	KPI01



Definition	Actual taxi-out time compared to an unimpeded/reference taxi-out time.
Mesurement Units	Minutes/flight
Onerations Measure	ar The duration of the favi-out chase of departing fights
Operations measure	the duration of the tax-out prices of departing ingines
Variants	Variant 1 – basic (computed without departure gate and runway data)
	Variant 2 - advanced (computed with departure gate and runway data)
Objects Characteriz	edThe KPI is typically computed for individual airports, or clusters of airports (selection/grouping based on size and/or geography).
Utility of the KPI	This KPI is intended to give an indication of the efficiency of the departure phase operations on the surface of an aerodrome. This may include the average queuing that is taking place in front of the departure runways, non-optimal taxi routing and intermediate aircraft stops during taxi-out. The KPI is also typically used to estimate excess taxi-out fuel consumption and associated emissions (for the Environment KPA). The KPI is designed to filter out the effect of physical airport layout while focusing on the responsibility of ATM to optimize the outbound traffic flow from gate to take-off.
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. Recommended approach for the advanced variant of the KPI: a separate value for each gate/runway combination, e.g. the average actual taxi-out time recorded during periods of non-congestion (needs to be periodically reassessed).
Data Requirement	For each departing flight:
	Actual off-block time (AOBT)
	Actual take-off time (ATOT)
	In addition, for the advanced KPI variant:
	Departure gate ID
	Take-off runway ID

Identify: ✓ Definition

- ✓ Data Requirement
- ✓ Data Feed Providers

KPI Name	Airport peak arrival capacity
ID	KPI01
Definition	The highest number of landings an airport can accept in a one-hour time
	frame.
Measurement	Number of landings / hour
Units	
Variants	None
Parameters	None
Data	Scheduling parameters for slot controlled airports
requirement	Airport Acceptance Rates (AAR)
Calculation	At the level of an individual airport:
procedure	1. Select highest value from the set of declared arrival capacities
	2. Compute the KPI: convert the value to an hourly landing rate, if the
	declaration is at smaller time intervals
References	Comparison of ATM-Related Operational Performance: U.S./Europe
	(June 2014)
	CANSO Recommended KPIs for Measuring ANSP Operational
	Performance (2015)
	2016-2030 Global Air Navigation Plan(Doc 9750-AN/963 Fifth Edition -
	2016)









Accessibility, Quantity, and Quality

- In-house
- Request to other organization
- Acquisition from Commercial Provider

- Completeness of data
- Data Mapping/Integration across multiple DBs

- Frequency of updates
- Data Format (Data Cleaning)
- Accuracy (Sensor vs. manual input)
- Validity

- Performance Evaluation
 - Who will process the data?
 - Does the data/ do the results make sense?

I. Determining Data Sources EROTHAL



Sample data sources: KPI Additional Taxi-out time

AOBT/ATOT/RWY/Gate

- Provider: ANSPs
 - Automatic Docking Guidance System
 - Manual inputs from ATCs
 - MLAT
 - FPL (DEP Message)

AOBT/ATOT/RWY/Gate

- Provider: Airport
 - Manual inputs from gate operators
 - FPL (DEP Message)

Off chock/ATOT/RWY/Gate

- Provider: Airlines
 - Manual inputs from pilot



Off chock/ATOT/Gate

- Provider: Commercial
 - Acquire inputs from airlines

II. Case Study: Integrated FPL data source EROTHAL



"Flight plans and related messages are fundamental information to ATM"

Operational Problems: 2009

- Quality of FPLs and related messages □ Validity, accuracy □Completeness
- Interoperability issues between multiple Flight Data Management Systems (FDPSs)
- Inefficiencies in handling FPLs and related messages by multiple parties (AROs, FDOs, ATCs)

Performance Analysis- difficulties

- ACC Flight Strip System was the only integrated source of FPLs.
- Statistical analysis was only possible for those flights that pass through Bangkok ACCs.
- Multiple FPLs occur when ATC need to correct/reprint strips.
- Incomplete data for evaluation for TMAs and aerodromes.



II. Case Study: Integrated FPL data source EROTHAL

AEROTHAI's Solution:

Flight Data Management System

- Ensures the validity of FPL & related messages (at some levels)
- Improves completeness of FPL records
- Reduces inefficiencies in message handling process
- Easy message entry process for operators
- Replaces manual routine steps with automation
- Scalable







II. Case Study: Integrated FPL data source

Expected Outcome

- ✓ Flight information with ensured quality in the hands of controllers
- ✓ Reduced number of 'no-flight plan' events
- Reduced numbers of rejected messages at FDPS

Benefits for Performance Measurement

- ✓ Single source of validated/reliable FPL data & related messages covering the entire BKK FIR for statistics/billing purposes
- ✓ Automation ensures accuracy/formats
 ✓ Reliable Data Cleaning Service
- Allows Mapping of En-route/TMA/Aerodrome data
- Can be extended to map FPLs with other sources such as surveillance/ATFM





Question: Can we build a more cohesive picture of our organizational performance?

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III. Looking to the Future: Data Analytics





III. Looking to the Future: Data Analytics

Integrated Data Infrastructure: What does it enable?





III. Looking to the Future: Data Analytics

Future of analytics...



...in the making

In Summary...

1. 2. 3. 4.

Know your questions
Understand your sources
Verify your data
Expand as you mature

Analysis – Producing more than just a single number

Speaker



Carol Teo Head (Data Science)

CAAS

Regional Focus



Analysis – Producing more than just a single number.

Content

Asia Pacific Performance Measurement Framework Phase 1 KPIs

Case study 1: Efficiency KPIs





Asia Pacific Performance Measurement Framework Phase 1 KPIs are designed to cover 3 KPAs across different flight phases

S/N	KPI	KPA	GANP
1	Airport peak arrival capacity		KPI09
2	Airport peak departure capacity		KPI09
3	Airport arrival throughput	Capacity	KPI10
4	Airport departure throughput	KPI10	
5	Additional taxi-in time	Efficiency	KPI13
6	Additional taxi-out time KP		KPI02
7	Flight arrival punctuality		KPI14
8	Flight departure punctuality	Predictability	KPI01

Measuring these 8 Asia Pacific Performance Measurement Framework Phase 1 KPIs only requires 6 data but it will provide insights into ANSPs', airports' and airlines' performance



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Measurement Framework

- Taxi-out additional time
- Taxi-in additional time



KPIID	KPI02
KPI Name	Taxi-out additional time
Definition	Actual taxi-out time compared to an unimpeded/reference taxi-out time
Measurement Units	Minutes/flight
Variants	Variant 1 – basic (computed without departure gate and runway data)
	Variant 2 – advanced (computed with departure gate and runway data)
Operations measured	The duration of the taxi-out phase of departing flights
Object(s) characterized	The KPI is typically computed for individual airports, or clusters of airports
	(selection/grouping based on size and/or geography)
Utility of the KPI	This KPI is intended to give an indication of the efficiency of the departure phase
	operations on the surface of an aerodrome. This may include the average queuing that
	is taking place in front of the departure runways, non-optimal taxi routing and
	intermediate aircraft stops during taxi-out. The KPI is also typically used to estimate
	excess taxi-out fuel consumption and associated emissions (for the Environment KPA)
	The KPI is designed to filter out the effect of physical airport layout while focusing on
	the responsibility of ATM to optimize the outbound traffic flow from gate to take-off.
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
	 Recommended approach for the advanced variant of the KPI: a separate value
	for each gate/runway combination, e.g. the average actual taxi-out time
	recorded during periods of non-congestion (needs to be periodically
	reassessed)
Data requirement	For each departing flight:
	 Actual off-block time (AOBT)
	 Actual take-off time (ATOT)
	In addition for the advanced KPI variant:
	- Departure gate ID
	- Take-off runway ID
Data feed providers	Airports (airport operations, A-CDM), airlines (OOOI data), ADS-B data providers and/
	ANSPs
Formula / algorithm	At the level of individual flights:
	1. Select departing flights, exclude helicopters
	2. Compute actual taxi-out duration: ATOT minus AOBT
	Compute additional taxi-out time: actual taxi-out duration minus unimpeded taxi-o
	time
	At aggregated level:
	4. Compute the KPI: sum of additional taxi-out times divided by number of IFR
	departures
References & examples	Comparison of ATM-Related Operational Performance: U.S./Europe (June 2014)
of use	PRC Performance Review Report (EUROCONTROL 2015)
	Single European Sky Performance Scheme
	CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

Measurement Framework – Determining the unimpeded times



- Before we start measuring the taxi-out additional time, the nominal taxi-out time already provided insights into the
 - Pushback patterns and restrictions;
 - Taxiing route;
 - Runway queue

Measurement



1 February 2019



- Longer taxi-out additional time than taxi-in additional time was observed which could be due to
 - Taxiway congestion
 - Runway queues
 - Longer push back
- While taxi-in and taxi-out additional times have already taken the longer taxi times due to distance from stands into consideration, we observe higher variance in taxi-in and taxi-out additional times for gates that were situated further away from the dominant arrival and departure runways respectively



Deep dive into departing stands

- Deep-dive further into the gates with higher taxi-out additional times
 - Airfield design
 - Pushback procedures
 - Taxi route







Deep dive into taxi-out additional time by hour of day



- Deep-dive into the hourly taxi-out additional time gives an indicator of the hours where efficiency is reduced and mitigation measures can be taken to enhance efficiency e.g.
 - Better distribute departure demand throughout the day
 - Departure manager (DMAN) to sequence aircraft to maximise runway capacity
 - Better gate allocation to avoid placing aircraft with similar offblock time at adjacent gates

Computing airport peak capacity

KPI ID	KP109
KPI Name	Airport peak arrival capacity
Definition	The highest number of landings an airport can accept in a one-hour time frame (also called
	declared arrival capacity, or airport acceptance rate)
Measurement Units	Number of landings / hour
Variants	None
Operations measured	The capacity declaration of an airport
Object(s) characterized	The KPI is computed for individual airports
Utility of the KPI	This KPI indicates the highest landing rate that an airport will accept, using the most
	favorable runway configuration under optimum operational conditions. The runways
	may or may not be the most constraining factor for airport capacity: at some airports
	the most constraining factor may be the terminal airspace, the taxiways, the number of
	gates, passenger handling capacity etc. The KPI is typically used for scheduling and
	ATFM purposes, and to develop capacity investment plans.
Parameters	None
Data requirement	Scheduling parameters for slot controlled airports
	Airport Acceptance Rates (AAR)
Data feed providers	Airports
Formula / algorithm	At the level of an individual airport:
	1. Select highest value from the set of declared arrival capacities
	2. Compute the KPI: convert the value to an hourly landing rate, if the declaration is at
	smaller time intervals
References & examples	Comparison of ATM-Related Operational Performance: U.S./Europe (June 2014)
ofuse	CANSO Recommended KPIs for Measuring ANSP Operational Performance (2015)

- Airport peak (arrival/ departure) = declared slots (arrival sublimit/ departure sub-limit)
- Airport peak capacity = declared slots
- This can be measured on per hour/ per 15min-basis

Computing airport peak throughput

KPI ID	KPI10
KPI Name	Airport peak arrival throughput
Definition	The 95 th percentile of the hourly number of landings recorded at an airport, in the "rolling"
	hours sorted from the least busy to the busiest hour
Measurement Units	Number of landings / hour
Variants	Variant 1: IFR arrivals only
	Variant 2: IFR + VFR arrivals (relevant for airports with a high percentage of VFR traffic)
Operations measured	The actual number of landings at an airport
Object(s) characterized	The KPI is computed for individual airports
Utility of the KPI	This KPI gives an indication of "busy-hour" landing rates at an airport, as recorded
	during a given time period. For congested airports, this throughput is an indication of
	the effectively realized capacity; for uncongested airports it is a measure of demand.
Parameters	Time interval for "rolling" hours. Recommended value: 15 minutes.
	The percentile chosen to exclude outliers. Recommended value: 95 th percentile.
Data requirement	For each arriving flight:
	 Actual landing time (ALDT)
Data feed providers	Airports
Formula / algorithm	At the level of individual flights:
	1. Select arrivals, exclude helicopters
	At the level of individual "rolling" hours:
	Convert the set of landings to hourly landing 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 95 th percentile of the "rolling"
	hours
References & examples	Comparison of ATM-Related Operational Performance: U.S./Europe (June 2014)
of use	

- Airport throughput

 number of movements in an hour, 15 mins rolling (ref. runway)
- Airport peak throughput = 95percentile of hourly airport throughput



Comparing daily throughput and capacity



- Comparison of throughput and capacity provides insights into how effective the airport is in handling demand
- Throughput measure will show up "busy hours" of the airport e.g.
 - 0600-1159 UTC for arrivals
 - 0000-0259 UTC for departures
- While Changi Airport was able to cope with the traffic demand (KPI10) across all hours, it gave us an indication of the hours where Changi Airport was operating near peak capacity and mitigation measures can be taken to avoid a situation of demand exceeding capacity



Studying how often airport operates near capacity



ArrThruput-15mins vs. DepThruput-15mins. Color shows sum of Number of Records. Size shows sum of Number of Records. The data is filtered on Time Of Arr Orep Year, which keeps 2016.

> Peak capacity 80% of peak capacity 60% of peak capacity

- In most airports, there are capacity sub-limits imposed on top of capacity limits
- Deep-diving into the numbers will allow us to study how often airport operates "near capacity", which can be denoted by a pre-determined percentage (e.g. 80% or 60%) of peak capacity
- Mitigation plan can be taken to minimize situation where demand cannot be accommodated

Conclusions

- Initiating performance measurement can be very low cost as it does not require extensive data sets nor extensive coverage
- Performance measurement provides insights into how well an airport/ANSP performs and analysis will help identify areas requiring improvement and mitigating measures can be implemented
- Analysis provides a trigger for airports and ANSPs to take action







Questions

and

Answers

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Thank you

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