Review of Airservices Australia's ATFM Delay Attribution Framework

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IATA Consulting

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Executive summary

This report provides recommendations and considerations to enhance ATFM delay attribution framework in Australia. It expands on the findings of a detailed review and observation of Airservices Australia's (Airservices) Air Traffic Flow Management (ATFM) and related reporting framework and presents a concise summary of its strengths and opportunities, along with a set of recommendations and considerations to enhance the delay attribution framework in Australia.

Airservices aims to establish a dependable methodology that fosters a shared understanding among ATFM stakeholders regarding delay attribution. They also aim for transparency in the attribution of ATFM delays and to reduce liabilities arising from Air Navigation Service Provider (ANSP) attributed delays. Airservices has engaged IATA Consulting to provide the following:

- Benchmark the ATFM performance observed at Australian airports to comparable global operations and understand the underlying causes and contributory factors to ATFM delays in Australia.
- Assess the data and processes by which ASA records, categories, and reports delays. This includes assessing if delays in practice are recorded appropriately.
- Assess whether those processes are robust and follow existing best practice guidance.
- Gauge level of collaboration between airlines, airports and the ANSP to share knowledge and jointly discussed issues to address ATFM delay challenges collectively.

The Airservices' framework shows overall effectiveness, and their approach is to be transparent with stakeholders and fair in delay attribution. However, there are specific areas of deficiency and uncertainty that warrant short- and medium-term attention. These include the need for real-time adaptability, transparent and standardized guidelines for assessing the impacts of staff disruptions, clear lines of decision-making authority, improved stakeholder engagement mechanisms, more detail in reporting data.

In summary, the key findings of the project team were in four topics. These are expanded in section 2:

<u>Delay and Cancellation Attribution:</u>

- Potential error and uncertainty in data collection and calculations affects the accuracy and reliability of the ATFM delay attribution framework. This can skew the quality, reliability and usefulness of the reported data;
- Clear guidelines are required for assessing the impact on capacity of staff disruptions in decision-making processes;
- The process for assigning delays needs to enhance its adaptability to real-time changes for optimal performance;

- A more detailed data collection and layered reporting system needs to be established for accurate delay attribution and determination of GDP compliance; and,
- Stakeholder engagement mechanisms can be enhanced for more transparent and effective communication.

Technical Limitations

- The current GDP modelling is supported by an early version of Harmony (V3) limiting a holistic view of the network; and,
- Current ATM and ATFM systems are not fully integrated with some components of the information exchange still done manually.

Accountability & Governance

- There is a need for clearly defined and communicated Operational Control Authority (OCA) in the NCC; and
- The current ATFM Business Rules have not been reviewed or updated for a significant period of time.

The report firstly looks at addressing key data, process and system issues identified in the review and analysis activities with a focus on identifying where there are deficiencies in the quality of data collection and processing procedures currently employed and how they may be improved. It then pays attention to the operational aspects, including business rules and ATFM solutions and provides comparisons of Airservices' existing ATFM delay attribution framework to international standards and best practices.

The report also looks closely at calculating compliance and at methods to improve the attribution of delay and cancellations.

In summary, this report aims to identify area where improvements may be made in Airservices' ATFM delay attribution system by delivering recommendations from the detailed analysis and global industry standards. Throughout the report there are also statements made for Airservices' consideration. This is where the authors believe it is outside the scope of being a formal recommendation but could be beneficial to the end-state objective of improving the ATFM delay reporting framework.

1 Introduction

1.1 Overview

This report sets out the findings of a detailed review and observation of Airservices ATFM and related reporting framework. It is focused on delivering targeted recommendations for enhancing the current ATFM delay attribution framework and aligning with international best practices.

The review observed the daily operation of the Network Coordination Centre (NCC) and evaluated the existing ATFM delay attribution framework against international standards and best practices. It identified areas of contention among stakeholders and aims to provide actionable recommendations to enhance the current ATFM delay attribution framework employed by Airservices through dual objectives:

- Improved data collection and processing mechanisms: enhance performance monitoring capabilities and facilitate more informed decisions and optimized resource allocation.
- Alignment with international standards and best practices: align Airservices' ATFM delay framework with global best practices, to enhance the system's efficiency and improve stakeholder relations.

1.2 Activities and Methodologies

Review activities involved analyzing the data and findings from the project to identify areas of deficiency and potential improvement. The analysis and the recommendations were segmented into two main focal areas:

- Data collection and processing mechanisms: This involved the observation of the daily operations of the NCC, discussions with the Network Performance and Analysis team, and examination of data collection, accuracy, and subsequent treatment within the framework. The goal was to discern the strengths and weaknesses inherent in the existing data collection and processing mechanisms. In addition to data collection, processes were examined, including ATFM business rules and solutions, including measures and capacity optimization.
- International standards and best practices: The report also concentrates on where Airservices' delay attribution framework does, or should, align with global benchmarks, specifically the Manual on Collaborative Air Traffic Flow Management (ICAO Doc.9971), as well as other industry best practices such as the CANSO Guide on ATFM/A-CDM Integration, the ICAO APAC ATFM Post-Operations Analysis Recommended Framework, and IATA guidelines such as their suite of delay codes in the IATA Airport Handling Manual (AHM).

Throughout the delivery of the module, the IATA Consulting team carried out internal research and data analyses. Reporting sessions were conducted between IATA and Airservices to discuss the project's progress on a weekly basis or as deemed necessary and convenient for the project team.

The on-site visit focused on observing daily operations, reviewing materials, data sources, performance, reports, analysis team operations, and meeting with relevant stakeholders, including the customer engagement team and GDP stakeholders. The on-site visit took place on week #4 and week #5 of the project, corresponding to the dates from the 30th of August to the 8th of September. The table below summarizes the reported activities:

Location	Date	Activity
Remote via Teams	7th of August 2023	Kickoff meeting
Remote via Teams	August (11th, 25th) Sept (8th, 20st) Oct (6th, 16th, 19th)	Report meetings
Remote	7th of August–29th September	Back-office work, including data analysis and report drafting
Canberra, Australia	30th-1st August 2023	First on-site visit
Melbourne, Australia	4th–6th September 2023	Second on-site visit

Table 1: Summary of reported activities

Within the data collection and processing mechanisms, this report looks at multiple layers of focus to gain a thorough understanding to identify potential deficiencies in specific areas of focus including:

- Data accuracy and business rules
- ATFM measures
- Sectors identification
- Impact of staffing levels
- Capacity optimization
- Air Traffic Management (ATM) solutions

The report also maintains a focus on compliance with international standards and best practices, encapsulated in the following elements:

- KPIs and compliance
- Framework improvement
- Cancellation attributions

1.3 Review synopsis

The review and assessment determined that the current framework aligns with ICAO Doc 9971 for effective capacity and demand prediction, and there exists a basis for effective delay attribution reporting, however several improvements could be made through addressing specific limitations, particularly related to reliability of data.

Of note, and to provide additional context as to how the discussions and analyses evolved in the formulating of the recommendations in this report, Appendix C contains a summary of a task conducted during the discovery stage of the project to identify the areas of real or perceived deficiencies between CDM participants and Airservices.

In summary, Airservices is concerned by the drop in familiarity the airlines have with effectively using the slot-swapping process, the lack of transparency in cancellation reasons, and the drop in GDP compliance.

Airline concerns include a need for more transparency of staff impacts on capacity, overall network effects of multiple concurrent GDPs, and the need for more detailed reporting to better identify calculations and causes of delays.

2 Key Findings

2.1 Overview

This section looks at the findings of the Project team's information discovery activities, discussions, research and analysis. It lists elements further discussed in section 3 identified for the attention of Airservices.

2.2 Delay and Cancellation Attribution

2.2.1 Areas for attention

- Standardization & Transparency: Clear guidelines are required for assessing staff disruptions in decision-making processes:
  - Absence of use of standardized capacity data for sector volumes adds to the subjectivity of determining a rate for a GDP-A, particularly with respect to staff shortages.
  - Determination of airspace capacity for the current GDP X-Factor is based on the strategic setting of staffing and sector opening using historical data as well as planning and proposed airspace changes. This historical data is not transparent during the process and the outcomes appear inconsistent and sometimes subjective.
  - Feedback from CDM participants confirmed that the X-Factor decisions on different days often appear inconsistent and subjective.
- Real-time Adaptability: The system needs to adapt to real-time changes for optimal performance:
  - The Ground Delay Program (GDP) may be re-run at any time, and often is based on material changes to the inputs. Re-run of the GDP each time following the Initial Schedule Evaluation (ISE) was initially identified by the project team as a potential benefit however extensive discussion with the Airservices team, and comparison with similar previous experience with ATFM for Sydney international arrivals, indicated that it would introduce inefficiencies and was also not previously supported by the airlines.
  - Introduction of the Digital Twin business system is intended to provide additional input to the METCDM process and improve network effects subsequent to the initial GDP assessment.

- Processing international flights where there are large variations in arrival time from their schedule times which had been accounted for in the GDP. The variations in real-time can create resultant airborne delays for other aircraft in the GDP.

- Data Reporting and Inconsistencies: A more detailed data reporting system needs to be established for accurate delay attribution and determination of GDP compliance:
  - To a new or non-regular reader, it is not clear what ground delay measurement is actually reported making it difficult for users to interpret what input drove the outcomes.
  - Potential error and uncertainty in data collection and calculations affects the accuracy and reliability of the ATFM delay attribution framework. This can skew the quality, reliability and usefulness of the reported data. For example:
    - Definitions of delay and compliance calculation include milestone time elements (eg: COBT and AOBT) that can differ from the actual data points collected for calculation (eg: CTOT and ATOT). This is due to data availability limitations, particularly the unavailability of AOBT in real-time. Airservices is aware of these limitations.
    - For ground delay, there are several data point comparisons that can result in varying differences in times and resultant delay reporting.
    - There can also be uncertainty in some of the data collected (eg: ATOTs from remote ports) so the calculating introduces potential error in the reporting results. While there are efforts to query all non-compliant flights, AOBT and ATOT data from airlines could support more accurate determination of delay attribution and GDP compliance.

- Stakeholder Engagement: Improved engagement mechanisms are critical for transparent and effective communication:
  - All parties need to be prepared to openly report and share the causal factors behind any delays, cancellations, or other impacts.
  - There is no defined and detailed set of attributes for airlines to provide all reasons for flight cancellations, including when it is independent of any GDP being run.
  - There is also no detailed set of attributes to identify where delay is attributable to airports or other sources.

2.2.2 Technical Limitations

- System Fragmentation:
  - Software Version: The current GDP modelling is supported by an early version of Harmony (V3) limiting a holistic view of the network. It is worth noting that Airservices is working toward addressing these limitations by implementing a new software solution that is known as Digital Twin. The current limitations in relation to network effects is linked to the metering aspects for the traffic departing the TMA and their downstream impacts.
  - Integration:
    - Current ATM and ATFM systems are not fully integrated for automated information sharing with some of the exchange still completed manually. Harmony has one-way automated information transfer from EUROCAT or the Maestro tool. It does receive flight plan and arrival estimate data automatically from EUROCAT. No data flows back from Harmony to EUROCAT.
    - A-CDM / ATFM integration was identified and discussed however is not possible in Australia at this time due to A-CDM implementation having just commenced. As a result, data quality and the additional source are presently limited however Airservices intends to integrate the two in the future.
    - Compliance with one GDP can impact on the ability to comply with another GDP depending on compounding impacts to subsequent flights and given that the programs are run independently.

2.2.3 Accountability & Governance

- Not having Operational Control Authority (OCA) in the NCC creates some issues as it was not immediately clear if the NCC has the accountable authority to determine the final GDP rates and if required, over-ride the rate from the Traffic Manager (TM). This is different to similar centralized network management models used in Europe, USA and other States.
- The current ATFM Business Rules have not been reviewed or updated for a significant period of time and several of the rules were identified as no longer being relevant or had been adapted for the current environment.

3 Recommendations to action Key Findings

3.1 Scope of the task

This section offers recommendations and considerations for actioning the Key Findings and their elements listed in section 2. Thus, covering the tasks of formulating recommendations to improve data collection and processing mechanisms as well as formulating recommendations to improve delay attribution framework (KPIs definition, cause of delays, attribution of a percentage of delay, etc.).

Solutions for the different elements includes enhancing data quality and the roles of various business entities and processes in the data process, and improving Airservices' ATFM delay attribution framework, based on the assessment of its alignment with international standards and industry best practices.

3.2 Delay and Cancellation Attribution

3.2.1 Recommendations based on International Standards & Best Practices

The overall implementaton of Airservices ATFM embraces the principles of CDM and ATFM illustrated by ICAO Doc. 9971, however uncertaintly in accuracy and reliability of the data used in calculating delays and compliance can lead to inaccurate reporting and unfair attributions to any and all stakeholders at times.

In the Australian Aviation Network Overview FY 2023 the measurement of performance is focused on three key areas, Delay Attribution, Cancellation Attribution and GDP Compliance. This foundational set of KPI is supported by the current Airservices metrics and framework; however, improved data accuracy and expansion of the KPIs that are reported on will improve the report processes and outputs.

3.2.2 Delay Attribution

In the Airservices current process Total System Delay is measured by the number of hourly periods with Calculated Landing Time (CLDT) in place and provides a macro level measurement of the delay program. This measurement of delay is related to delay imposed by the ATFM processes but does not account for additional delay that could be encountered during the flight. Total System Delay has two components; delay attributable to ATC Staffing; and delay attributable to all "Other" causes. The ATC Staffing component of the Total System Delay is calculated after all other causes have been accounted for. If after implementing a GDP, demand continues to exceed capacity, the additional delay required to balance the system is attributed to ATC Staffing and subtracted from the Total System Delay.

The Airservices Staffing attribute is reported as being related to overall ATC staffing shortages, not specific to a particular ATC specialty. It is worth also noting that there are occurrences where reduction in rates due ATC staffing does not result in demand exceeding capacity and therefore no requirement for a GDP-A to be run.

To further refine delay attributable to Airservices staffing, there should be metrics put in place to support collection of data related to delays on specific city pairs, by ATC Specialty. This can be measured using the recommended parameters and processes for Declared Capacity. When attributing the additional delay for staffing, it can be specifically attributed to the airspace volume (for example: ATC Staffing: Sydney TMA). The method of calculation will remain the same as are presently used; however, the specialties where staffing is a critical issue will be evident.

Recommendation 1: Airservices expand the attribution of delay due to ATC staffing by the affected city-pair/s and of the area of staff impact:

- ATC Staffing Enroute;
- ATC Staffing TMA; and
- ATC Staffing Tower.

Similarly, the current "Other" category of delay attribution could be of more value if broken down into sub components. The "Other" category for Attribution of Delay could be further divided into: Weather, which is uncontrollable; CNS outage, controlled by Airservices; and Environmental Restrictions, Security Events and Military Activity all of which are under external control. Slot reduction/delay minutes could be broken out and attributed to each category as part of the pre-tactical planning to produce a representation of delay that is not controlled by, or attributed to, Airservices. This will support Airservices in determining if it is an ATS staffing shortage or some other specific factor as detailed below, that is primarily contributing to the delay.

- Weather: The pre-tactical METCDM is used to determine if a capacity reduction at one or more of the four major airports in Australia is necessary due to the forecast weather. If a reduction is warranted, the number of airport slots available per hour is determined. Once the number of proposed flights is known, a comparison to the number of available airport slots is made and a determination of the requirement for a GDP is assessed. This initial ground delay is attributed to Other and is not broken out as a separate metric for weather.
- CNS: Concurrent with the Airservices staffing assessment, other factors such as Facilities, NAVAIDs, and conducting of flight checks are assessed to determine if there are additional impacts on capacity. If capacity is affected, additional slots are removed from the GDP thus increasing the total system delay. This additional delay is not measured separately but is included in the total delay time attributed to the "Other" category.
- Airport: Additional restrictions on capacity are further reflected in the removal of slots and attributed to the "Other" category. These include airport restrictions due to airport staffing, maintenance, or construction, unserviceable airport equipment, and emergencies such as airport shut down due to fire or bomb threat. These issues are coalesced in the "Other" category without a method to determine what is causing the delay.

- International arrivals: Airservices data indicates that non-conformance to the GDP by affected flights has increased over pre-covid rates which could impose a delay to other aircraft in the arrival queue. International flights are included in the GDP protocols; however, their slot allocations rely on flight plan data or early estimates and they are tactically controlled as they arrive in the TMA. When international flights arrive at times materially different to that utilized in the GDP-A, the result can be holding or extended flight paths for all flights in the arrival queue. The tactical methods employed by ATC to safely accommodate all aircraft can result in delay that is not currently accounted for in the Total System Delay. LR-ATFM procedures have previously been developed for Australian trials and should be considered for more assessment.
- Non-compliance: Similar to the impact of international airlines entering the sequence at times materially different to the flight plan times used in the GDP calculations, non-compliance by domestic flights require tactical management by ATC and can create airborne delays to other CDM Participants which compounds the already absorbed GDP delay.

There is also a full suite of IATA codes which could be used as a baseline for a broader array of attributes.

Expanding the categories of delay attribution to a more granular process will enable a change of delay reporting from a macro level to a more refined approach.

Recommendation 2: Airservices collaborate with CDM Participants to expand the "Other" category of delay attribution to include areas of delay attribution according to the affected city-pair/s and the area of impact. This could be based on international examples and guidance such as CANSO or IATA codes and could include:

- Weather;
- CNS Equipment (including flight calibration);
- Airport (including security events (Military/Police actions), and infrastructure);
- Processing international arrivals; and,
- Non-compliance.

There are additional KPIs that Airservices could consider assisting in understanding the causes of systemic delay. These are discussed further in section to define elements for 'layered' reporting of delay attribution.

3.2.3 Cancellation Attribution

Flight cancellations are an indicator that reside in the KPA of Predictability. From the ANSP perspective it is important to understand the percentage of ANS related flight cancellations during ATFM interventions. Consumers tend to equate predictability with reliability; therefore, consumers are likely to view a predictable ATS system with confidence.

Airservices has defined two areas of cancellation attribution: Cancellations related to ATS and Other Cancellations. Together these two KPIs represent the third KPI of Total of Cancellations, that occur during the periods that ATFM measures are in place. Flight cancellations that occur prior to the initial Harmony run are not counted in the total. Public reporting in the ATFM Dashboard and the annual corporate report readily identify the portion of the Total Cancellations that are attributed to ATS related cancellations and those that are attributed to the "Other" category.

As a comparator, the FAA utilizes four categories (KPI) of cancellation attribution as follows:

- Air Carrier: The cause of the cancellation or delay was due to circumstances within the airline's control (e.g. maintenance or crew problems, aircraft cleaning, baggage loading, fueling, etc.).
- Extreme Weather: Significant meteorological conditions (actual or forecasted) that, in the judgment of the carrier, delays or prevents the operation of a flight such as tornado, blizzard or hurricane.
- National Aviation System (NAS): Delays and cancellations attributable to the national aviation system that refer to a broad set of conditions, such as non-extreme weather conditions, airport operations, heavy traffic volume, and air traffic control.
- Security: Delays or cancellations caused by evacuation of a terminal or concourse, re-boarding of aircraft because of security breach, inoperative screening equipment and/or long lines in excess of 29 minutes at screening areas.

Three of the four FAA KPI, Air Carrier, Extreme Weather, and National Aviation System Flight contain metrics that can be associated to ATFM measures. While delays due to security issues are important to consumers, these are considered an Airport Operator concern and are unlikely to be associated with the ANSP or the ATFM, so are omitted from further discussion here.

Air Carrier: Flight cancellations are an important KPI that is used by the airline industry to measure their performance. Airlines can have many reasons for cancelling a flight. Some are based on internal factors, such as unserviceable equipment or unavailable crew members, and others on external factors such as an ATFM delay. Air Carrier's internal performance measurement processes typically require attribution of a reason for cancellation; however, this information is not currently provided to Airservices. The result is that all cancellations that occur during a GDP are attributed to ATFM measures. The provision of a reason for Air Carrier cancellation is an enabler for Airservices to accurately attribute cancellations during a period of ATFM intervention. This KPI could be better assessed and attributed with just two metrics based on data from the Air Carriers. The first metric is Cancellation=Air Carrier Internal, and the second is Cancellation=GDP. Accurate data from the Air Carriers supporting these two metrics will enable Air Services to improve the accuracy of the total cancellations attributable to the GDP.

Extreme Weather: This KPI is currently included in the Airservices "Other" cancellations category; however, it could be useful to measure flights the Air Carrier would have cancelled due to weather independent of ATFM measures. Implementation of this KPI would require the Air Carriers to provide a data point for an additional metric of Cancellation=Extreme Weather. In consideration of the mechanisms to obtain data from the Air Carriers implementation of this KPI is not recommended at this time but could be considered in the future.

National Aviation System: This KPI is similar in nature to the existing KPI of Arrival Cancellations Attributable to Airservices. The purpose of this KPI is to measure the effect of ANS capacity disruption on traffic and to measure the impact of the flow management strategy during period of significant airport capacity reduction. In the Airservices case, cancellations are attributed to the ANS only if the GDP is a result of ATC staffing. Currently measurement of this KPI is in place for the period of GDP; however, there are plans to expand it to apply to a three-hour period post GDP.

The three KPI related to cancellations that are in place by Airservices meet the requirements to support cancellation attribution and are very similar to those in use by the FAA. Improvement to the current system is possible through an accurate accounting on the part of the Air Carriers of the reason for the cancellation. If Air Carriers provide the cancellation data of "Air Carrier Internal" or "GDP" the accuracy of the number of cancellations related to the GDP will improve. If the overall number of cancellations attributable to the GDP is reduced, then the percentage of cancellations attributable to Airservices will also be reduced.

The delay codes included in the IATA Airport Handling Manual (AHM) may also provide a good basis for more detailed and accurate attribution of cancellations.

> **Recommendation 3:** Airservices collaborate with CDM Participants on a methodology to collect improved data related to the reason for cancellations during a GDP. Airservices should then use this data to improve the attribution of cancellation to ATS or Other.

3.2.4 GDP Compliance

Airservices measures GDP compliance as the difference between ATOT minus last allocated CTOT prior to departure. The rule defined by Airservices is that a flight is in compliance if departure is within -5 / +15 minutes. Therefore, Airservices publishes within reports such as the Australian-Aviation-Network-Overview, the airline GDP compliance for Sydney, Melbourne, Brisbane, Perth from all ports. These published numbers represent the compliance at the destination airport considering their compliance at the origin (ATOT-CTOT). In other words, if an airline departed from Sydney with ATOT-CTOT that is higher than 15 minutes, it is reported as non-compliant at the destination airport.

The metering tactic employed is primarily a Ground Delay Program (GDP). Aircraft arrivals to each of the four airports are metered to ensure efficient use of the arriving airport infrastructure without imposing

further enroute delay. Although the Airservices GDP is based on COBT for each flight, GDP compliance is measured using data/metrics that do not include the COBT or the AOBT. Accurate measurement of compliance to the GDP requires a new source of data for these two data points. As discussed later in this document, collection of these data points could be part of any new A-CDM implementation.

ICAO GANP KPI03 ATFM Slot Adherence, measures compliance/non-compliance with the GDP. Airservices is already using a form of this KPI and has defined the compliance window of -5/+15 minutes of CTOT as compliant. Eurocontrol's Measuring Operational ANS Performance at Airports KPI 7 Adherence to ATFM slot, requires that a similar window of minutes to be used. However, the uncertainty associated with the measurement of the compliance at the runway can cause some confusion when comparing the compliance to the Airservices ATFM. The AOBT data to accurately measure this metric is not currently available to Airservices through any manual or integrated system. Instead, the metric is based on ATOT-CTOT which provides an approximation of the measurement of the ATOT.

Refer to Recommendation 7 and related content for suggested improvement to data collection for measurement of GDP compliance.

3.3 Areas for attention

The Airservices Network Management Framework provides the high-level methodology for matching the ANS system capacity to demand through the ATFM program. In line with international standards, the framework represents the methods and processes to attribute ATFM delay to factors associated with Airservices' restrictions. Use of a GDP-A for flights to the four major airports Brisbane, Sydney, Melbourne and Perth is considered a norm for managing flow. Perth may also use a GDP-D when required due to weather.

The framework also supports the data collection required to populate the public dashboard as well as the various reports that are part of the system. The KPIs that are measured are focused on ATFM delay and cancellations, and data is used to attribute delays or cancellations to Airservices or other. Metrics are defined to support information/data gathering related to the KPIs; however, in some cases the metrics are inaccurate or based on the incorrect data points.

This section addresses specific areas of deficiency and uncertainty that warrant short- and medium-term attention.

3.3.1 Standardization and Transparency

In the pre-tactical GDP negotiation (referred to as the METCDM process), a decision on any capacity impacts of staffing is made by the duty Traffic Manager (TM). This estimate of airspace capacity is based on the strategic setting of staffing and sector opening using historical data as well as planning and proposed airspace changes. The historical data is not transparent during the process and the outcomes

appear inconsistent and sometimes subjective. While capacities are published for the airports, the absence of capacity figures for sector volumes to use as guideline for staffing impacts can result in a margin for error or inconsistency, with slots unnecessarily removed and delay outcomes attributed to Airservices.

> **Recommendation 4:** Airservices conduct assessments to determine the nominal baseline capacity of airspaces that are associated with the four major airports (Brisbane, Sydney, Perth, and Melbourne). The assessment should also set operational capacities based on common scenarios such as reduced staffing, weather events, and ATM system outages. These operational capacities should be used by the NCC (and future NOMC) to make the final determination of the METCDM rate.

3.3.2 Real-time Adaptability

The Ground Delay Program (GDP) may be re-run at any time, and often is based on material changes to the inputs.

After the initial GDP run, airlines utilize the ISE to exchange slots to optimize the day's flying program which often includes cancellation of several flights. As this changes many of the COBTs, Airservices has limited indication of the whole of network effects and if the GDP parameters remain valid for retaining a program at any specific location. This visibility could permit the NCC at times to be able to reduce GDP hours.

Extensive discussion identified that a re-run of the GDP post-ISE would simply be a 're-set' and likely introduce inefficiencies. Prior experience with managing Sydney international arrivals supports this argument and in fact the airspace users in that discussion did not support it. Introduction of the Digital Twin business system is intended to provide additional input to the METCDM process and improve network effects subsequent to the initial GDP assessment.

Harmony does make some allowance for arriving international flights. A CLDT/slot is attributed to international flights; however, in keeping with CANSO recommendations, a CTOT is not coordinated at the early stages of the flight. International flights are tactically accommodated and managed by ATC as they arrive in Australian controlled airspace; however, these flights may cause congestion within the TMA of an airport that is subject to A GDP-A similar to non-compliance by a domestic CDM Participant. The tactics employed by ATC could include holding, extended flight paths, or vectoring. Each of these measures increases the ATC workload and has the potential to further delay other flights operating within the TMA.

To support inclusion of international flights operating to an airport with a GDP-A, other ATFM measures may be used. Two common practices include Calculated Time Over (CTO) and Required Time of Arrival (RTA), which are in relation to the constrained airport. Within Harmony, international arrival flight plans are analyzed to determine if the arrival falls within a period of GDP-A, thus requiring an arrival slot. From the ELDT assigned in the GDP, the flight could then be allocated a CTO to enter the TMA or some other point along the route permitting the aircraft to adjust its speed to be compliant. This may influence flight

participation on ATFM measures and how delay is attributed where CANSO indicates a target of 70% flight participation including regional, and international, to make such a concept effective.

Airservices currently does not have jurisdiction to issue CTOTs outside of Australian FIRs which themselves are very large so some neighboring FIRs are significantly far away. These techniques are considered advanced but are aligned with the intent of International Standards and Best practices. Airservices has substantial experience with the use of ATFM measures and should consider their implementation.

The data required to implement CTO or RTA is twofold: data required by the ATFM includes flight plan and flight progress information from other ANSPs; data out includes the CTO and RTA data to be supplied to the operator in time to be of use.

3.3.3 Data Reporting and Inconsistencies

Currently, the delay imposed by a GDP is attributed to either ATC Staffing or "Other".

In the Airservices ATFM system measurement delay is based on the metric of COBT as calculated by Harmony. The Total Ground Delay Reported is calculated by the sum of differences between COBT-BEOBT or COBT-ELOBT respectively (whatever is lower) and which are both (BEOBT/ELOBT) attributed through the Harmony system. The final assignment of COBT slot occurs after ISE; therefore, the final delay may be quite different than the original assigned delay.

ICAO standards and CANSO recommendations base KPI related to delay on the difference between metrics of ETOT and ATOT. Where ETOT is the original airline planned time of take-off and the ATOT is the actual time of take-off. This delay indicates the difference between the planned departure and the actual departure measured at the runway. Airservices has access to the original airline planned take-off time through the flight plan submission. Currently, ATOT information for each flight may be inaccurate.

Because the Total Ground Delay Reported is calculated using COBT and BEOBT or ELOBT, and the COBT is taken after the ISE slot swapping process, the delay reported by Airservices is generally significantly less than the total delay of initial GDP-generated COBT-IOBT from airline schedules.

Additionally, methods for determining system delay do not capture further delays that could be encountered after aircraft leave the gates that are not a result of the GDP. Measurement of this further delay can be determined by subtracting the Actual Landing Time (ALDT) from the Estimated Landing Time (ELDT) which was used to develop the initial COBT.

As a KPI, Taxi Out Additional Time measures one area where flight duration can be affected. The time to taxi from the gate to the runway can become extended if airport infrastructure is unavailable (closed taxiways), taxi clearances from ATC are delayed, or due to queueing at the departure runway. Implementing this KPI requires establishment of a value for unimpeded taxi time to be used as a

comparator. The KPI is measured by subtracting AOBT from ATOT and comparing the result to the established nominal taxi time value.

The GDP COBT is calculated based on an estimated slot time at the arrival airport; therefore, if taxi out time at the departure airport is extended, there is the real possibility that the flight may not meet the allocated In Block Time (IBT). This potential additional delay is not accounted for in the current measurement of Total System Delay.

There are several ways to calculate and report delay and the current method would benefit from considering reporting multiple layers of delay so that attribution can be more fairly assessed and calculated. More transparent reporting would clearly describe all layers of reporting so stakeholders can interpret what input drove the outcomes. As well as the Total Ground Delay Reported defined above, the following delay calculations are relevant:

- Total of calculated (GDP generated) delay: defined and calculated as total of GDP generated COBT-IOBT from airline submitted schedules. This would be the most accurate measure of how much delay the ATFM process has created based on the planned schedules. The methodology for attributing delay would be the same as for currently attributing between MET and staff impacts.
- Total Delay from ISE outcomes: defined and calculated as total of post-ISE COBT-IOBT from airline submitted schedules. This would be the most accurate measure of how much expected delay remains after the ISE process based on the first GDP run. The methodology for attributing delay would be the same as for currently attributing between MET and staff impacts, with the need for stakeholder engagement to further identify where the ISE process may add to delay for any individual flight and how that is attributed.
- Taxi Out Additional Time: to track further delay beyond that imposed by ATFM measures such as a GDP. The sub-elements of 'Other' delay attribution can be utilized to identify if it is an ATM, Airport or infrastructure related delay. It is noted that successful delivery of the current A-CDM project in Australia will benefit this calculation by providing more options for the data to support this measurement (ABOT and ATOT).

States participating in the Asia-Pacific Multi-Nodal ATFM Cooperation (AMNAC) follow guidelines that report ATFM delay as CTOT-ETOT where CTOT is GDP-generated, and ETOT is based on the flight's originally intended operations[1]. This would align to the Total of Calculated (GDP generated) Delay.

[1] ATFM Post-Operations Analysis Recommended Framework, Version 1.0 November 2020, para 5.8

The Airservices team has only two categories for reporting attributable delay: Ground Delay Airservices Attributed (due staffing), and Ground Delay "Other" Attributed. This immediately limits the ability to identify further what was the primary causal factor in generating the requirement for the delay.

CANSO guidance sets out common categories of delay: ATC, Capacity, Weather, Airline and Other, with sub-categories under each one. IATA also has a detailed suite of codes for delay attribution that can be referenced.

The majority of impacts from staff shortages are occurring in a subset of towers and sectors; however, total reported coverage is diluted when included with overall staff coverage for both FIRs. More detail in reporting can provide appropriate delay attribution to the staffing areas of issue.

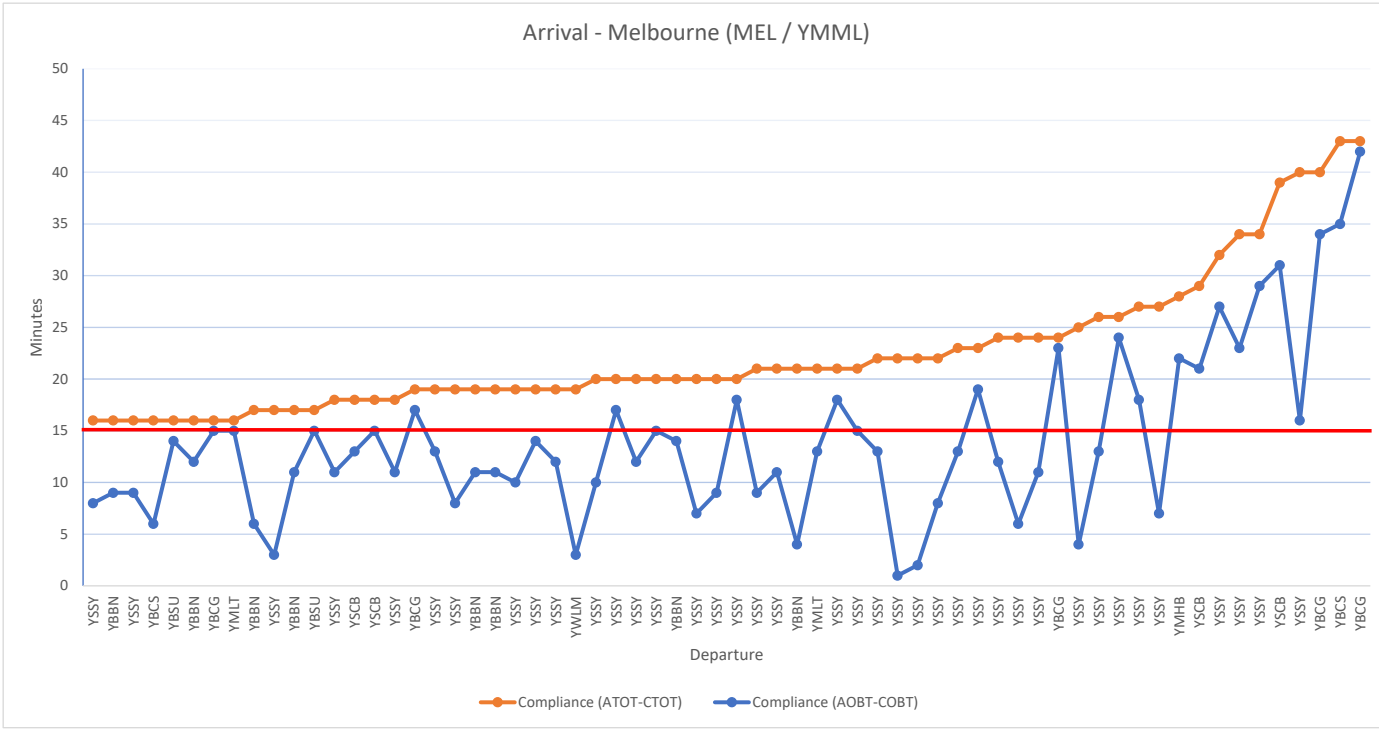
> **Recommendation 5:** To provide more transparency in reporting of delay attribution, Airservices, in collaboration with CDM Participants, to construct a table of reporting codes based on the CANSO, IATA or other recognized international guidance or benchmark examples.
>
> **Recommendation 6:** Airservices to define and provide 'layered' reporting of total delay calculations to contrast the varying total delays at different stages of the ATFM process. In designing the 'layers', Airservices to gauge likely effectiveness by seeking the input of CDM Participants.

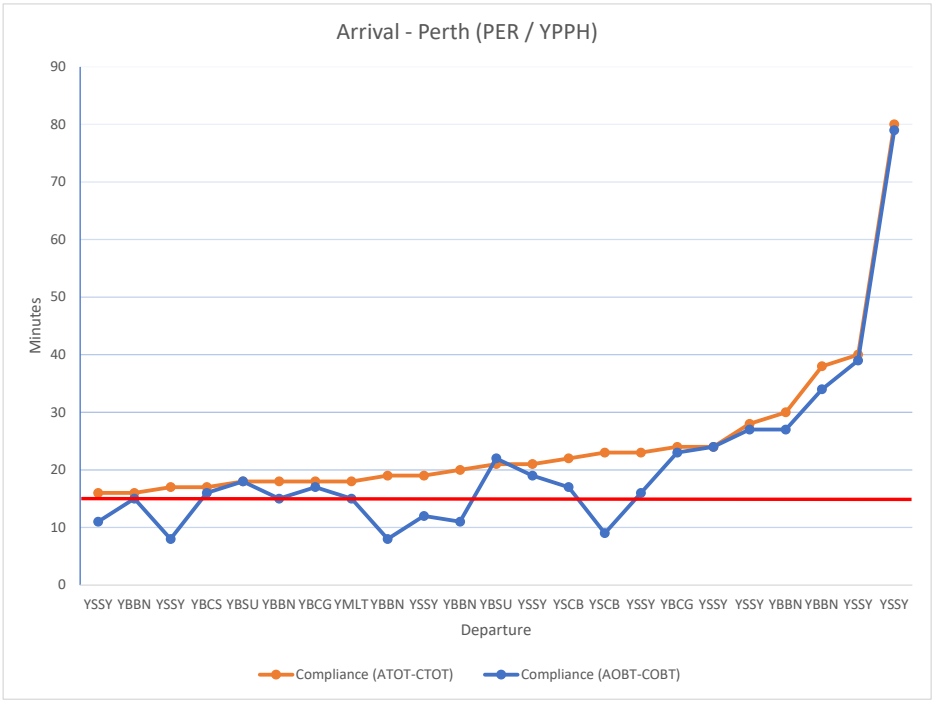
Internationally, it is accepted that GDP compliance supports the overall effectiveness of the ATFM program. Conversely the higher the percentage of non-compliance with GDP, the less effective the GDP will be. Airservices annual reporting indicates that GDP non-compliance has been increasing since 2019, with FY2023 having an overall average of 22% non-compliance. Eurocontrol requires a corrective action plan when non compliance is 20% or more for regulated flights at an airport. Reduction in the percentage of GDP non-compliant flights should be a goal for Airservices.

Airservices provided a data sample in relation to GDP compliance for a one-week period. Considering this data, IATA conducted several data analysis with the objective to support the recommendations highlighted below.

Compliance accuracy was highlighted in the preliminary report due to the uncertainty effect of the nominal Taxi-Out Times (TTOs), the aproximation for the measurement of the ATOT as well as the CTOT calculated by Harmony. The accuracy of the GDP compliance can be evaluated when comparing the GDP compliance at the runway (ATOT-CTOT) and the GDP compliance before Off-Blocking (AOBT-COBT).

In order to do this, IATA collected AOBT data from the airlines, performed the analysis and gathered the data within the following diagrams. These diagrams illustrate the flights that were not in compliance according to Airservices' records (ATOT-CTOT) and the GDP compliance measured through AOBT-COBT. The blue line represents the GDP compliance before the Off-Block and the orange is the GDP compliance at the runway reported by Airservices.





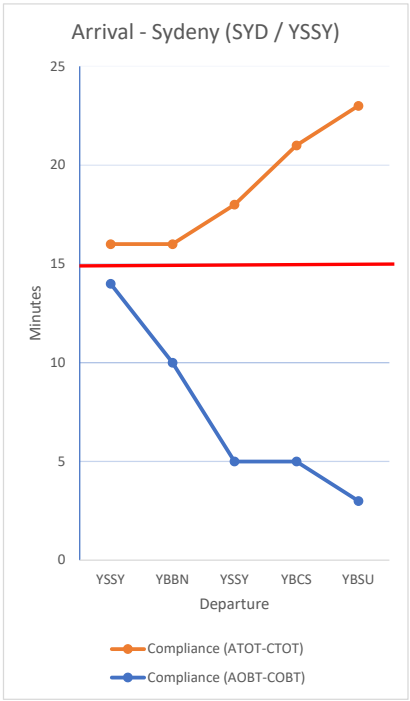


Figure 1: GDP compliance at the runway (ATOT-CTOT) vs GDP compliance at the apron (AOBT-COBT) for MEL, PER & SYD

The diagram indicates that some of the flights that were not in compliance (above +15min) at the runway, were in compliance when off-blocking. This corroborates the fact that the estimation at the runway could result on a GDP compliance that is not accurate. The international best practices make reference to the measurement of the compliance window at the runway (CTOT) or push back (COBT). When comparing data from Airservices to that provided by some airlines, discrepancies in GDP compliance rates become apparent.

In future planned ATFM / A-CDM integration, the GDP compliance process at a departure A-CDM airport will move away from using COBT (AOBTs will become available). However departures from any other non-A-CDM airports will still be affected by not having real-time AOBT data provided to the NCC.

> **Recommendation 7:** Perform accurate calculation of GDP compliance. The evaluation of GDP compliance at the apron will reduce the level of uncertainty and will improve the accuracy. The source of data for accurate AOBT should be considered. It is noted that successful delivery of the current A-CDM project in Australia can benefit this Recommendation by providing more options for data in future calculations at airports with A-CDM capability.

Moreover, Airservices' GDP compliance is reported at the destination airport. This provides good valuable insights regarding the GDP-A. However, the measurement it is stating is the GDP compliance at the destination airport based on data (CTOT-ATOT) that corresponds to the departure.

Note: The analysis above is done for illustrative purposes based on the information provided by Airservices which has been compared to Airlines' information. It is out of the scope of this report to perform an exhaustive analysis of GDP compliance for a longer period of time, which could be done as part of a separate piece of work.

3.3.4 Stakeholder Engagement

International standards related to flight cancellation attribution are not defined. Cancellations of scheduled flights occur regularly during the pre-tactical and tactical phases of the ATFM process used by Airservices. Airlines may cancel flights for many reasons, not all of which are related to ATFM measures. The current process measures cancellations after the initial ISE takes place; however, this is acceptable as these flights are more likely to accurately reflect the demand for the day.

Cancellation data should be accurate and collected through automated processes whenever possible. When airlines cancel a submitted flight plan it is recorded as such, but a reason for the cancellation is not requested or provided. Flight plan cancellations are assessed to determine if the cancellation occurred during a period when the ILDT of the flight during an active GDP was adjusted as a result of ATC Staffing. If the cancellation occurred during a period when arrival slots were reduced only due to ATC Staffing then the cancellation is attributed to Airservices, otherwise it is assumed to be other.

While the logic used to attribute actual flight cancellations to Airservices is sound, it is still diluted by cancellations during those periods, and others, where the cancellations may have been for any of several other reasons.

Additionally, a potential difficulty with the attribution of cancellation is due to the foundation data related to capacity. While there is no set matrix for staff impacts, if additional slot reduction was imposed due to ATC Staffing, but was ultimately not required, then some flight cancellations may not have been required. In this case the foundation data element of capacity, upon which the data metrics are based may lead to inaccuracies.

Recommendation 4 in section 3.3.1 states that Airservices conduct assessments to determine the nominal baseline capacity of airspaces that are associated with the four major airports (Brisbane, Sydney, Perth, and Melbourne), as well as set operational capacities based on common scenarios such as reduced staffing, weather events, and ATM system outages. That recommendation is also relevant here.

Recommendation 3 in section 3.2.3 calls for Airservices to consult with CDM Participants to develop and utilize a standardized coding for providing reasons to the NCC for flight cancellations, including when it is independent of any GDP being run. That recommendation is also relevant here.

3.4 Technical Limitations

3.4.1 System Fragmentation

Harmony has been employed as the Airservices ATFM software since inception in 2010. The software has been upgraded several times by the manufacturer.

The effect of ATFM in a network environment is very evident in a system like that of Eurocontrol. In the ATFM single deployment system of Airservices there is still a network of two FIRs and four major airports to consider. ICAO and Eurocontrol both recommend that assessment of network effects is an important attribute of a robust ATFM program. The demand/capacity assessment completed by Harmony does not currently consider network effects.

Airservices is currently developing a business system called Digital Twin to assist in ATFM modelling. It can help simulate real scenarios and their outcomes for the entire network, ultimately allowing it to make better decisions. However, the technology will require accurate aircraft performance characteristics, current MET models and accurate airspace descriptions to operate effectively. While this is providing a potential solution, a Harmony upgrade or new technology should remain in considerations, particularly as new systems such as those in the One-Sky program come online.

The current suite of tools used in ATFM are not fully integrated with ATS systems. Some information is exchanged; however, in some cases, manual manipulation of the data/information is required. Automated tools for assessing for network effects during each GDP run are not employed.

Maestro is currently in use to manage the arrival sequence at the four major airports. It uses actual position and speed information to determine the landing order of aircraft and displays this information to air traffic controllers. The controllers then use this information to sequence aircraft using speed control, vectoring, or holding to achieve an orderly air traffic flow.

Harmony currently has very limited connectivity to ATS system functionality. The EUROCAT 2000 ATS system provides for an external data feed through the Flight Information Broker (FIB) which can update ATFM times (FIB to Harmony). The Harmony ATFM system also accepts Maestro STA (the runway ETA) data, providing up-to-date arrival information for airlines and airports.

Within the four major airports there is potential to improve data gathering through the pending implementation of A-CDM processes. Like ATFM, the A-CDM process is designed to support efficient flight operations. Two-way sharing of data and information between airport operations and ATFM operations can improve both processes to eliminate or reduce inefficiency in the management of air traffic. Information sharing through integrated A-CDM and ATFM processes can support predictability of the overall system and related performance reporting.

Implementation of A-CDM has only just commenced early project phases in Australia so at this time it doesn't exist at the four major airports; therefore, data exchange between the ATFM unit and the airports is limited.

While the airports system could benefit from the provision of data from the ATFM system, the exchange of flight departure information would support the Airservices ATFM system as it currently lacks a source for accurate off-block, start-up and take-off times. Airservices plans to integrate ATFM and A-CDM once the latter rolls out which means more relevant and accurate data elements will become available at A-CDM airports for managing compliance.

An A-CDM program at the four major airports could provide the capture and exchange of accurate high-quality data related to departures. It is recognized that not all flights affected by the ATFM measure of GDP originate at one of the four major airports. However, for those that do A-CDM, data will be useful for measuring GDP compliance as well as provide accurate information on aircraft movements using ATFM compliance process that will change to CTOT complied through TSAT.

A further benefit of implementing A-CDM is the data required for Pre-Departure Sequencing (PDS) or Departure Manager (DMAN), whose main objective is to support the optimization of the departure sequence.

3.5 Accountability and Governance

3.5.1 Decision Authority

Airservices promotes a holistic, cooperative and collaborative decision-making environment and runs periodic workshops covering varying topics with the aim of balancing the expectations of the members of the ATM community in Australia to achieve the best operational outcome.

There exist two primaries international ATFM concepts of operation. One of them is the centralized approach implemented regionally as in in Europe, USA and some other States. The other one is the distributed ATFM network concept that is implemented in regions such as Asia-Pacific, Latin America and the Caribbean and currently at definition stages in the Middle East. Airservices applies a centralized ATFM concept and thus, utilizes a centralized NCC unit providing ATFM service in Australia. This is aligned with the European model.

Accountabilities for the NCC are included in the Network Operations Manual (NOPM), however it is not immediately clear who has the authority to determine the final GDP rates. At times the NCC supervisor may not agree with the additional X-Factor applied by the TM and proceed with a different determination however it was reported that this does not occur often due the TM's Operational Control Authority (OCA). Not having assigned OCA in the NCC creates some issues as it was not immediately clear if the NCC has the authority to over-ride the rate from the Traffic Manager (TM). It is expected that the move to the NOMC will resolve this.

The ATFCM Operations Manual for the Network Manager at Eurocontrol indicates the leadership of the Network Manager Operations Center and its accountability for the specific ATFM performance targets on a daily basis.

This report supports the work the ATM Director team is currently undertaking to implement a standardized matrix to manage the inconsistent application of the X-Factor in relation to staffing restrictions. This would grant better autonomy to the NCC for assessing and determining the capacity rates, making the process more efficient, consistent and transparent.

> **Recommendation 8:** As part of the move to the Network Operations Management Centre (NOMC), Airservices to clearly define and communicate internally that the Operational Control Authority (OCA) for final determination of the daily capacity rates ultimately rests with the NCC/NOMC, who would use the outcomes of Recommendation 4 in their daily analyses.

3.5.2 ATFM Business Rules

A review of the existing ATFM Business Rules was conducted during the project. It was noted that several of the business rules were no longer relevant or had been adapted for the current environment. Overall, it was acknowledged that the current business rules had not been reviewed or updated for a significant

period of time, the last full update likely completed in pre-COVID times, and that the NCC team had initiated a review. The ATFM Business Rules could be updated based on an event-based approach. A table of events would assure that timely review of the business rules is undertaken when required. Identified events should include as a minimum:

- Soft/firmware changes in existing ATFM platforms (Example: Harmony upgrades);
- Implementation of new ATFM tools (Example: Digital Twin);
- Changes to, or implementation of, other ATM Tools that interface with ATFM tools; and,
- An annual review where no other review has been initiated in the preceding twelve months.

Recommendation 9: Airservices complete a review of the existing ATFM Business Rules on a priority basis and implement an event-based approach to future reviews. Involving CDM Participants in the reviews would be beneficial.

3.6 KPAs and KPIs

Airservices already has a set of KPIs, but these are locally defined and there may be benefit in closer alignment with the CANSO recommended KPAs/KPIs.

To support the KPA of Airspace Capacity, CANSO recommends the use of three potential KPI: Declared Capacity; Capacity Utilization; and, Delay Attributed to Capacity. Currently, Airservices is using only the latter KPI to attribute delay due to ATC Staffing.

The KPI of Declared Capacity is an indicator of the upper threshold on the quantity of flights that can be safely accommodated through a defined airspace. Declared Capacity is typically set through an analysis process that measures the capacity of the airspace under normal conditions with appropriate staff. Both CANSO and Eurocontrol have published examples of methodologies to conduct capacity assessments. Once established, Declared Capacity can be adjusted when abnormal conditions or staffing issues occur. The results of a capacity assessment are critical to the use of the KPIs of Capacity Utilization and Delay Attributed to Capacity.

As bottlenecks have historically been related to airports, declared capacities are determined for them. Airservices does not have a declared capacities in place for its controlled airspace segments and particular the impacts to capacity from staffing changes. Current practice is to declare capacity daily, based on a subjective assessment by the Traffic Manager responsible for the affected airspace using historical data for the strategic setting of staffing and sector opening. This can result in an under or over estimation of the operational capacity of the airspace. Without a definition of the baseline capacity it is difficult to accurately attribute delay to capacity. Recommendation 4 in section 3.3.1seeks to address this.

In the 2023 Australian Aviation Network Overview, Airservices is predicting that combined domestic and international passenger traffic will grow to 113% of 2019 (Pre Covid) levels by 2026. This prediction is based on Tourism Futures International modeling in June 2023 and broadly agrees with IATA predictions for passenger growth in the Asia Pacific Region. To accommodate this passenger growth extra airline capacity will be required, putting pressure on a system that is already regularly constrained. Without a baseline capacity assessment, it will be difficult for Airservices to understand where demand will regularly exceed capacity.

Airservices uses a metric called Capacity Predictability which looks at the ability to plan and deliver the correct capacity. This is similar to the CANSO KPI of Capacity Utilization which is useful in measuring the effectiveness of the ATM system during normal and abnormal operations. Capacity Utilization is not dependent on a GDP being in place. Once a declared capacity for an operational period is established, metrics can be recorded to determine the efficiency of the ATM system. Example: If a TMA has a declared capacity of 25 movements per hour due to weather and demand is for 28, Airservices would be measured against its' ability to safely handle 25 movements. Calculations are based on the metrics of dividing the accommodated demand by the lesser of the actual demand or the available capacity. In the case where the 25 movements are accommodated, the system is at declared capacity and Airservices is operating at 100% efficiency. If fewer than 25 aircraft are accommodated during the period, then the system is operating at less-than-optimal efficiency. Conversely, if more than 25 aircraft are accommodated, it is likely the Declared Capacity was set too low or one of the factors used to set the capacity has changed. A sector that is often operating at or above capacity is an indication that capacity optimization measures should be considered. This metric is an indicator of efficiency and the accuracy of Declared Capacity and can be used to identify areas that require performance improvement.

If Declared Capacity and Operational Capacity for both airports and airspace were to be determined and implemented as a process in assessing the daily capacity, they could support a Capacity Utilization KPI or current Capacity Predictability metric in determining the efficiency of ATC in the enroute and TMA phases of flight.

A version of the KPI "Delay Attributed to Capacity" is currently in use by Airservices; however, the metrics in place support attributing portions of the Total Delay to "ASA Staffing" and/or "Other" categories. The accuracy of delay attributed to ATC Staffing as a percentage of Total Delay could be improved with implementation of formal processes associated with Declared Capacity as stated above.

Recommendation 10: Airservices to evolve present KPIs to more closely align with international guidance for KPIs in design, application and terminology. This alignment will support improved stakeholder engagement by utilizing more standardized global practice.

4 Concluding remarks

This report delivers actionable recommendations to enhance the current ATFM delay attribution framework employed by Airservices Australia (Airservices). In constructing the report, the project team built upon the analysis of detailed review and observations and now present related recommendations for the issues identified.

The Airservices' framework shows overall effectiveness, and their approach is to be transparent with stakeholders and fair in delay attribution. However, there are specific areas of deficiency and uncertainty that warrant short- and medium-term attention.

The current framework aligns with ICAO Doc 9971 for effective capacity and demand prediction, and there exists a basis for effective delay attribution reporting, however several improvements could be made through addressing certain limitations, particularly related to reliability of data for calculating delay attribution and compliance.

Specifically, areas discussed in this report relate to potential error and uncertainty in some data, the need for clearer guidelines for assessing the impact on capacity of staff disruptions, enhancing adaptability of the ATFM process to real-time changes, providing layered reporting to stakeholders, improving stakeholder engagement mechanisms, technical limitations, clear assignment of Operational Control Authority (OCA) in the NCC/NOMC, and a refresh of the ATFM Business Rules.

Appendix B lists the full set of recommendations that have been proposed in the document. The scope of the recommendations cover enhancing methods for determining capacity and attributing delay and cancellations more accurately; improving transparency in reporting compliance, delays, cancellations and related attributions to CDM Participants; increasing data quality and enhancing data processes, and; aligning practices as best as practicable to global standards and international best practices; and lastly, addressing the accountability and Business Rules of the NCC/NOMC.

Throughout the report there are also statements made for Airservices' consideration. This is where the authors believe it is outside the scope of being a formal recommendation but could be beneficial to the end-state objective of improving the ATFM delay reporting framework.

Some recommendations and considerations may rely on the timelines of out-of-scope enabling projects such as A-CDM implementation, and system upgrades, however those that are procedures related or changed data management activities should be considered for implementation as soon as practicable.

Success of implementation and effectiveness of the changes will be increased where Airservices maintains close collaboration with CDM Participants throughout the process.

Appendix A: Glossary of terms and acronyms

Term/ acronym	Definition
A/DMAN	Integrated Arrival and Departure Management
AAR	Airport Acceptance Rate
ACA	Airport Coordination Australia
A-CDM	Airport Collaborative Decision Making
AFIS	Aerodrome Flight Information Service
AFTN	Aeronautical Fixed Telecommunication Network
AIBT	Actual In Block Time
AIP	Aeronautical Information Publication
AIRAC	Aeronautical Information Regulation and Control
Airservices	Airservices Australia
AMAN	Arrival Manager
ALDT	Actual Landing Time
ANS	Air Navigation Service
ANSP	Air Navigation Service Provider
ANSPs	Air Navigation Service Providers
AOBT	Actual Off Block Time
ARDT	Aircraft Ready Time
ASA	Airservices Australia
ASAT	Actual Startup Approval Time
ASBU	Aviation System Block Upgrade
ASMA	Arrival Sequence and Metering Area
ASRT	Actual Startup Request Time
ATC	Air Traffic Control
ATFM	Air Traffic Flow Management
ATFM System	A system which provides demand and capacity management to airports and airspace volumes
ATFMU	Air Traffic Flow Management Unit
ATM	Air Traffic Management
ATMD	Air Traffic Management Director
ATOT	Actual Take Off Time

Term/ acronym	Definition
ATS	Air Traffic Services
AUs	Airspace Users
AVMET	Aviation Meteorologist
BEOBT	Base Estimate Off Block Time
BoM	Bureau of Meteorology
CANSO	Civil Air Navigation Services Organization
CDM	Collaborative Decision Making
CDM participants	Participants in CDM processes
CDMF	CDM Facilitator
CLDT	Calculated Landing Time
CNS	Communication, Navigation, and Surveillance
COBT	Calculated Off Blocks Time (for flights on a gate requiring pushback, this is the pushback time. For other flights this is the taxi time)
Compliance	Compliance is a measure of the difference between a flights actual operating time and the programmed time in the ATFM system.
CTO	Calculated Take Off Time
CTOT	Calculated Take Off Time
DAP	Departure and Approach Procedures
DPI	Departure Planning Information
EIBT	Estimated In Block Time
ELBOT	Earliest Operator Off Block Time
ELDT	Estimated Landing Time. Used in Harmony V7 as an alternative to ETA.
ELOBT	Earliest Operator Off Block Time
En Route	On the way
ERSA	En Route Supplement Australia
ESM	Enhanced Substitution Module is a plug-in subcomponent of ATFM for airline use to enable flight substitution
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
ETOT	Estimated Take Off Time. Used in Harmony V7 as an alternative to ETD.
EUROCAT	Eurocat X – ATC automation system
EXOT	Estimated Taxi Out Time
FFR	Fire and Flood Relief

Term/ acronym	Definition
FIB	Flight Information Broker
FIR	Flight Information Region
FIRs	Flight Information Regions
GANP	Global Air Navigation Plan
GDP	Ground Delay Program
GDP-A	Ground Delay Program applicable to flights arriving into the specified airport. A system of delaying departing traffic to meet en route or arrival slot times. A Ground Delay advice is associated with a COBT/CTOT.
GDP-A and GDP-D	Ground Delay Programs A and D (specific types of Ground Delay Programs)
GDP-D	Ground Delay Program applicable to flights departing from the specified airport. A system of delaying departing traffic to align departure demand with planned departure capacity. A Ground Delay advice is associated with a COBT/CTOT.
GSP	Ground Stop Program
HOSP	A flight plan status used to advise of a medical flight declared by medical authorities
IATA	International Air Transport Association
IBT	In Block Time
ICAO	International Civil Aviation Organization
IOBT	Initial Off Block Time
ISE	Inter Aircraft Operator Slot Exchange
KPA	Key Performance Area
KPI	Key Performance Indicator
LR-ATFM	Long Range Air Traffic Flow Management
LTOP	Long Term Operating Plan
Maestro	A tactical arrival management system
MATS	Manual of Air Traffic Services
MDI	Minimal Departure Intervals
MEDEVAC	A life critical medical emergency evacuation e.g. An aircraft proceeding to pick up, or carrying, a severely ill patient, or one for whom life support measures are being provided.
MET	Meteorological

Term/ acronym	Definition
METCDM	Meteorological Collaborative Decision Making
NAVAID	Navigational Aid
NCC	Network Coordination Centre
NCCMET	Network Coordination Centre Meteorologist
NDB	Non-directional Beacon
NOPS	Network Operations
OAG	Official Airline Guide
OCA	Operational Command Authority
Oversubscribed /oversubscription	Term used to describe when a port has has more air traffic presenting to land in one hour (or hours) that it can handle. E.g. 25 aircraft arriving in the 03z hour when the conditions only allow for an arrival rate of 20.
PANS	Procedures for Air Navigation Service
PBC	Performance-based Communication
PBN	Performance-based Navigation
PBS	Performance-based Surveillance
PI	Performance Indicator
POLAIR	An aircraft operated by the Police of a state of Australia
Pop-Up Flight	A flight that is scheduled or plans to arrive during the period of a GDP, but which was not known to the ATFM system when the GDP was issued. Pop-up flights are generally created from a flight plan that is filed after the GDP was issued.
Pre-tactical	From the day prior to the day of operation of a flight up to two hours prior to departure
Program Airport	An airport that is subject to a GDP
Purge	A cancellation of a GDP
QMS	Quality Management System
RNAV	Area Navigation
RTA	Required Time of Arrival
SAR	Search and Rescue
SARP	Standards and Recommended Practices
SATVOICE	Satellite Voice Communication
SIBT	Scheduled In Block Time
SID	Standard Instrument Departure

Term/ acronym	Definition
SM	ATC Shift Manager, interchangeable with TM
SM/TM	Slot Management/Traffic Management
SMC	Surface Movement Controller
SMS	Safety Management System
SOBT	Scheduled Off Block Time
STAR	Standard Terminal Arrival Route
STATE	A flight plan status used to advise of a Head of State or of Government is travelling on the flight
Strategic	More than one day prior to the day of operation of a flight
SWIM	System Wide Information Management
TACAN	Tactical Air Navigation
Tactical	Less than 2 hours prior to departure until the end of the flight
TAF	Terminal Area Forecast
TAWS	Terrain Awareness and Warning System
TM	ATC Traffic Manager
TMI	Traffic Management Initiative. A tool used to manage air traffic. Alternatively referred to as an ATFM measure.
TOBT	Target Off Block Time
TSAT	Target Startup Time
UHF	Ultra-high Frequency
VOR	VHF Omni-directional Range
Whispir	Multi-channel communication system used by the NCC for external notifications
XMANN	Extended Arrival Manager
YBBB	ICAO code for the Brisbane FIR
YBBN	Brisbane Airport
YMML	Melbourne Airport
YMMM	ICAO code for the Melbourne FIR
YPPH	Perth Airport
YSSY	Sydney Airport

Appendix B: List of Recommendations

Recommendation 1: Airservices expand the attribution of delay due to ATC staffing by the affected city-pair/s and of the area of staff impact:

- ATC Staffing Enroute;
- ATC Staffing TMA; and
- ATC Staffing Tower.

Recommendation 2: Airservices collaborate with CDM Participants to expand the "Other" category of delay attribution to include areas of delay attribution according to the affected city-pair/s and the area of impact. This could be based on international examples and guidance such as CANSO or IATA codes and could include:

- Weather;
- CNS Equipment (including flight calibration);
- Airport (including security events (Military/Police actions), and infrastructure);
- Processing international arrivals; and,
- Non-compliance.

Recommendation 3: Airservices collaborate with CDM Participants on a methodology to collect improved data related to the reason for cancellations during a GDP. Airservices should then use this data to improve the attribution of cancellation to ATS or Other.

Recommendation 4: Airservices conduct assessments to determine the nominal baseline capacity of airspaces that are associated with the four major air (Brisbane, Sydney, Perth, and Melbourne). The assessment should also set operational capacities based on common scenarios such as reduced staffing, weather events, and ATM system outages. These operational capacities should be used by the NCC (and future NOMC) to make the final determination of the METCDM rate.

Recommendation 5: To provide more transparency in reporting of delay attribution, Airservices, in collaboration with CDM Participants, to construct a table of reporting codes based on the CANSO, IATA or other recognized international guidance or benchmark examples.

Recommendation 6: Airservices to define and provide 'layered' reporting of total delay calculations to contrast the varying total delays at different stages of the ATFM process. In designing the 'layers', Airservices to gauge likely effectiveness by seeking the input of CDM Participants.

Recommendation 7: Perform accurate calculation of GDP compliance. The evaluation of GDP compliance at the apron will reduce the level of uncertainty and will improve the accuracy. The source of data for accurate AOBT should be considered. It is noted that successful delivery of the current A-

CDM project in Australia will benefit this Recommendation by providing more options for accurate times in future calculations at airports with A-CDM capability.

Recommendation 8: As part of the move to the Network Operations Management Centre (NOMC), Airservices to clearly define and communicate internally that the Operational Control Authority (OCA) for final determination of the daily capacity rates ultimately rests with the NCC, who would use the outcomes of Recommendation 1 in their daily analyses.

Recommendation 9: Airservices complete a review of the existing ATFM Business Rules on a priority basis and implement an event-based approach to future reviews.

Recommendation 10: Airservices to evolve present KPIs to more closely align with international guidance for KPIs in design, application and terminology. This alignment will support improved stakeholder engagement by utilizing more standardized global guidance.

Appendix C: Identification of deficiencies between ATFM stakeholders and Airservices

The objective of this task is to identify the areas of real or perceived deficiencies between CDM participants and Airservices. The principles of CDM described between ICAO Doc. 9971 reinforce the attributes of collaboration and agreement on a common goal that drives the decision. The Module 2 report of this project will more closely address recommendations for the issues identified.

Both the Airservices Australia teams and airlines expressed concerns regarding varying aspects of the ATFM process and the related performance reporting.

Airservices concerns:

- Airlines are responsible for liaising with each other to swap slots to best utilize the published capacity. Observation from the NCC team was that some airline staff don't appear to be as well versed on the use of Harmony as they were pre-COVID, and that the slot-swapping process is not used as efficiently or effectively as it could be. They noted it appears that there is not the same level of interaction and negotiation between airlines as there was pre-COVID. It was queried whether this is because of a change of staff and subsequent experience as a result of redundancies during the pandemic?
- Airservices reported they don't have sufficient transparency on why flights are cancelled and would like more clarity (numbers and reasons) for flight cancellations. Not knowing whether a flight was cancelled purely because of the GDP or otherwise for airline reasons (eg: loadings, crew times) makes it difficult to assign true attribution in the post-analysis process.
- The NCC team provided data showing how GDP compliance by participating airlines had dropped since pre-COVID operations. They were unsure what was causing this and suggested a need to move towards a more regimented requirement to comply with programmed COBTs as it is for the advantage of all stakeholders. Currently penalties for non-compliance are applied inconsistently, but Airservices' intention is to improve this process as per AIP. Late flights aren't normally punished however they still require slots to be identified and so they can be just as disruptive as early non-compliant flights.

Airline concerns:

- External daily reports don't include narrative on what drove X-Factor decisions, particularly from the Traffic Managers based on ATC staffing issues. All airlines engaged expressed concern at the lack of transparency as the X-Factor decisions on different days often appeared inconsistent and subjective.

- One reason observed is that there is no formalized guidance shared with the NCC or CDM Participants as to what impact on traffic management and rates that any specific staff shortage may have. Each Traffic Manager at the different locations applies local judgement and X-Factor decision to the METCDM process which often results in significantly differing outcomes.
- In the example of the GDP-A ran for Brisbane for 31 August, the pre-tactical data from the MET input and from the NCC staff indicated a slight reduction in likely capacity from 34 per hour to 32, 30, and 28 during different hours. The Traffic Manager during the METCDM process then reduced the rate by a further 8-12 slots per hour and included comments "Rwy 01L ILS on test. NOTAM C1055/23 refers" for the first part of reductions, and then "Due weather. Single runway config required" for the later hours due PROB30 TEMPO for TSRA. On the day of the program running, MET reforecast the weather to improved conditions and raised the MET CDM Final Rate by 2 slots for eight of the remaining nine hours of the program. This appeared to mitigate the primary reason for the original additional SM/TM X-Factor, however the TM on the day elected to retain significantly reduced rates and provided new comment "ENR staffing reduced". This was due an emerging staff issue on sectors south of Brisbane.
- If there was clear guidance for rates based on staff impacts, the NCC team could shorten the process and factor those into the METCDM process themselves. At times the NCC supervisor may not agree with the additional X-Factor applied by the TM and proceed with a different determination. This reportedly does not occur often as there is no assigned authority to the NCC over the operational authority that a TM has formally as part of their role. As noted in section 4.6, the ATFCM Operations Manual for the Network Manager at Eurocontrol indicates the leadership of the Network Manager Operations Center and its accountability for the specific ATFM performance targets on a daily basis.
- In line with the inconsistency that Airservices is seeing in the application of the X-factor, the ATM Director team is implementing a standardized matrix to manage the inconsistent application of the X-factor in relation to staffing restrictions.
- To a new or non-regular reader, it is not clear what reported ground delay is actually reported as there are several data point comparisons that can result in varying differences in times and resultant delays. More transparent reporting would clearly describe all layers so all stakeholders can interpret what input drove the outcomes. As well as the Total Ground Delay Reported defined in 3.2.2 above, the following delay calculations are relevant:
- Total of calculated (GDP generated) delay: defined and calculated as total of GDP generated COBT-IOBT from airline submitted schedules. This would be the most accurate measure of how much delay the ATFM process has created based on the planned schedules.

Total Delay from ISE outcomes: defined and calculated as total of post-ISE COBT-IOBT from airline submitted schedules. This would be the most accurate measure of how much expected delay remains after the ISE process based on the first GDP run.

This is also true for compliance measuring as definitions differ from the actual data used, and in cases there is an amount of uncertainty that can skew outcomes. Compliance of a flight is defined as AOBT-COBT however it is measured by ATOT-CTOT. This means that at a controlled airport the times include a set-parameter for taxi times that differ depending on duty runways, taxi paths and traffic. The uncertainty is exacerbated for flights departing uncontrolled airports, particularly in Western Australia, where the ATOT has to be reversed calculated from a FIB departure message or first 'coupling' in the EUROCAT system, and where it is not clear without confirmation from the pilot, as to what runway was used and departure path flown. This might result in an ATOT value that is several minutes after the actual take-off. This could erroneously label a flight as late non-compliant, but will not lead to any flight accidently labelled as early non-compliant. Where practicable, non-compliant flights presenting in Harmony are questioned with the airline by the NCC to confirm times before classifying the aircraft as non-compliant.

Cancellation of a flight often results in cancellation of what would have been the return leg for that flight. If the return destination also has a GDP-A running, the subsequent cancellation skews it from the start as it creates a slot vacancy that wasn't accounted for due to the reaction to the first GDP-A.

Compliance with one GDP can impact on the ability to comply with another GDP given that programs are run independently. This can also have significant duty time impacts for crews. (Noted that Airservices is developing a 'Digital Twin' with an external business technology provider which will look at the network as a whole to support Harmony decision making. The first phase of the Digital Twin is due to roll out this year.)

Periodic reports do not present a helpful portrayal of staff coverage and sometimes have data missing on outages. The majority of impacts from staff shortages occur in a few towers and sectors however total coverage is diluted when included with overall staff coverage for both FIRs. We also observed a weekly report that had omitted a disruptive impact in GWYDIR on the preceding Friday evening which the airlines noted had not been reported.

Airlines would like to see live-demand monitoring in order to be able to adjust flying programs tactically.

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