

# Questions from the Audience

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## Our Panelists



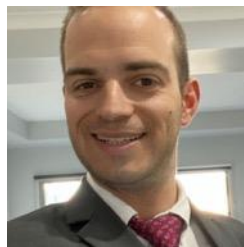
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## ATFM Post-Operations Analysis

**Q: Post-operations analysis should generally focus on measuring the efficiency and/or inefficiency of ATFM measures. On the *inefficiency* side, should we look at when ATFM measures are required but not used or when ATFM measures are used despite *not* being required? How do we determine whether the ATFM measures have been activated appropriately at the right time with the right parameters?**

- **Jesper Bronsvort:** Definitely, ATFM performance measurement should include whether ATFM measures were appropriately enacted or should have been enacted. To do this, the accuracy of predicting a potential capacity and demand imbalance is key, and requires an accurate view of future demand (good participation required by airline stakeholders) and airport/airspace capacity. The latter was reflected in the 'capacity predictability' KPI that was presented in the webinar by Airservices.

**Q: Is monitoring Ground Delay Program compliance on the departure side, i.e. CTOT/COBT compliance, sufficient? Should the compliance not also be monitored on the arrival/constraint side, i.e. monitoring of CTO/CLDT, as well; as many factors can influence aircraft trajectory while airborne resulting in aircraft not arriving in accordance with the ATFM plan?**

- **Phil Dowson:** Comparison between CLDTs and ALDTs is included in Airservices' post-operations analysis dashboard and forms part of the performance reporting. This particular measure is referred to as ATFM delivery accuracy and combines the impacts of operator compliance and GDP accuracy (GDP parameters, EET, etc).
- **Stuart Ratcliffe:** Yes, arrival compliance should be considered in addition to departure compliance as Airservices are doing. Should there be continued significant difference in the CLDT and the ALDT, investigation will reveal if data and trajectory modelling in the ATFM system is adequate. However there are many factors that can cause differences in CLDT and ALDT which should be investigated and rectified, for example, the EET of the FPL could be inaccurate or flights are flying at non-standard speeds to make up for the delay they have received at the point of departure, to name a couple.

**Q: How can we tackle the challenge of collecting data required to perform analytics?**

- **Stuart Ratcliffe:** Ideally, the data should come from the ATFM systems used to manage the traffic. Post Operations evaluation is an important part of ATFM and the ATFM system should have the capability to record all events and flight parameters for later extraction and analysis. Equipment suppliers are continually enhancing their post event analysis capabilities to ensure that all information is available to do post-event analysis.

**Q: How do we ensure post-operations analysis results are shared with stakeholders and their feedback provided back to the ATFM provider?**

- **Jesper Bronsvort:** For Airservices, we utilize many channels ranging from daily reports being pushed to stakeholders to regular (weekly, monthly/quarterly) debriefs with CDM members.
- **Stuart Ratcliffe:** It is important that post-operations analysis process and mechanism for a feedback loop between the ANSP and stakeholders get written clearly into the ATFM Concept of Operations from the time of the implementation. Making sure that stakeholders understand the importance of and the process for conducting analysis and debriefing is a crucial part of ATFM implementation. Ideally, monthly reviews (workshops) should be held to report back on system performance, identify target areas of concern, and propose solutions. The metrics should be tracked monthly to look for improvements. Oftentimes, just increasing awareness among the participants and stakeholders can have a positive impact.

**Q: How can the reduction in radar vectoring be measured?**

- **Stuart Ratcliffe:** Advanced ATFM systems have the ability to record the amount of time flights occupy terminal airspace where the majority of radar vectoring typically takes place, however, there are many factors which could contribute to extra time spent in the TMA – speed control, airborne holding, extended downwind legs etc. Again, modern ATFM systems have the ability to compare filed FPL versus what was actually flown; comparing the 2 routes, the amount of radar vectoring can be seen as a flight is taken off a SID/STAR for example. So, comparison between pre- and post-implementation of ATFM can be done to assess reduction in radar vectoring using both the time in TMA and filed FPL versus actual route flown.

**Q: Do ATFM measures result in lesser overall delays for flights, from the origin to the destination?**

- **Phil Dowson:** ATFM programs strategically manage delays and provide a more predictable outcome for a projected capacity and demand imbalance. The fundamental principle of ATFM is that delays are being managed in lower-cost phases of flights, without increasing overall delay. Depending on the accuracy of the predicted capacity for an ATFM program and the behavior of aircraft operators, there may be instances where the overall delay experienced by an operator is increased. It is therefore important that ANSPs work with aircraft operators to ensure sufficient flexibility is built into the ATFM concept, allowing aircraft operators to optimize ATFM slot allocation for their fleet, minimizing any potential for unnecessary delays.
- **Dan Schuller:** Not necessarily - but ATFM does provide the means to manage delay flexibly and adapt to those KPIs that are most important to the ANSP/Customers. Whilst managing overall delay will be a primary aim, there will be parallel aims to ensure individual flight delay is managed within acceptable parameters. There will always be a tradeoff between satisfying these different targets and external demands, but capability to measure and manage the ATFM options is essential.
- **Stuart Ratcliffe:** It would be great to be able to give a resounding yes to this question, however it is a complex issue that ATFM is trying to address. We work in a very dynamic environment where the situation changes so quickly, which makes this difficult to measure. Additionally, we cannot just measure the overall delay achieved; other questions need to be answered as well, e.g. safety enhancement, efficiency enhancement, fuel saving and CO2 emission reduction, and predictability improvement. There is definitely an increase in capacity as a result of ATFM measure implementation as the traffic becomes more manageable, which could lead to the reduction in overall delay. Generally, if an ATFM measure is applied at the right time to the right set of flights, then tactical/airborne delay is transferred back into ground delay, which is safer, easier to manage, and less costly for flight operators. It is also more predictable, more equitable, and extends greater operational flexibility to the flight operators. However, if the ATFM measure is used on too small a scale, or if applied at the wrong time, then it can actually increase overall delay.

## ATFM Strategy

**Q: Has ATFM begun to leverage new technologies such as AI, Internet of Things (IoT), and innovative algorithms, to improve operations for the future?**

- **Dan Schuller:** Yes, innovative algorithms are beginning to show up in ATFM. This is fully accepted at European future models through SESAR. Practically, probabilistic has certainly been included in European research in the context of network optimization and is used operationally within Europe. ATFM is an ideal environment for such innovation as - certainly in the planning environment - it does not carry the same level of safety assurance needed for ATC. So whilst we will see such innovation relatively quickly to support planning for tactical, the adoption within tactical itself will take longer - but will happen.
- **Stuart Ratcliffe:** Yes ATFM system providers are including AI and innovative algorithms into systems and continue to do so as developments are made in this area. In terms of IoT, system providers are continually looking at how various systems can be connected to each and how information can be easily shared among stakeholders for example. It is believed that much can be done in the future and the research continues.
- **Daniel Schauries:** In collaboration with Deloitte Digital, Airservices developed a Digital Twin simulator concept model. This innovative product will allow us to simulate a range of multiple operational scenarios before they happen and ensure the right ATFM decisions are made. See the link for a more detailed description in a recent WIRED magazine article:  
<https://www.wired.com/sponsored/story/deloittedigital-imagining-and-imagining-the-future-of-air-travel/>

**Q: In many places, stakeholders are still not aligned on the benefits of ATFM and what ATFM can enhance. How can we improve collaboration and alignment among various stakeholders involved in ATFM?**

- **Stuart Ratcliffe:** You will recall in my presentation the example I gave of an airline refusing to participate in ATFM implementation; this was as a result of lack of knowledge and understanding by the airline. The ANSP took the resolution to embark on an education process of all stakeholders involved in the ATFM process. After a period of time with multiple workshops held to explain the ATFM process and the expected benefits, this particular airline bought into the concept and became active supporters. CANSO has been very active in this education process in the past. It is important to include all stakeholders from the outset to ensure their complete buy-in to ATFM implementation. Post-implementation analysis and modeling can help. Stakeholders can be shown the impact on their operations currently, and then model what it would look like after ATFM is applied. They will show the benefits of ATFM implementation.

**Q: How does one overcome challenges in implementing ATFM measures given that different stakeholders have different objectives?**

- **Stuart Ratcliffe:** In implementing ATFM, it is important for the ANSP to understand the needs of various stakeholders. When assessing and reporting on the benefits of ATFM, the ANSP should take into account and be able to report specific benefits for particular stakeholders. Further to this, it is important to include the stakeholders from the outset of ATFM implementation so all their needs are taken into consideration when implementing ATFM and when putting an ATFM measure in place. Hence why CDM is an important component of ATFM, in which the needs of stakeholders are taken into consideration in all phases of ATFM. ATFM measures should be accompanied by facilities that allow each stakeholder to mitigate potential effects of disruptions in a way that makes sense to their operations. Examples of this for the airlines are slot swapping in a GDP/RFP and routing out of an airspace flow program.

**Q: In implementing ATFM, how can the staff be trained to analyze traffic for effective planning of ATFM measures?**

- **Vern Payne:** Within the FAA, training is a key initiative. Traffic Management Coordinators in the field facilities (Tower, Approach Control, ACC) all receive standardized training at the FAA Academy as well as on-the-job training and position certification. Annual refresher training as well as specific seasonal training is also conducted. At the FAA Command Center, the same or similar training and certification is conducted. This focus on training includes the analyzing of the data and emphasizes making data driven decisions for ATFM measures.
- **Stuart Ratcliffe:** CANSO strongly advocates appropriate qualifications and training for ATFM managers. They should have an ATC background; however, a good ATC does not necessarily make a good ATFM manager without the required skill set and temperament which are also important. Further to this, a good ATFM manager will have a good understanding of airline and airport operation and meteorological conditions prevalent in their area of responsibility. Comprehensive training should be given to equip the flow manager to be able to analyze both capacity and traffic demand, leading to a decision on when - and when not to - and how to implement an ATFM measure.

## ATFM Operations

**Q: What kind of messages are used to inform stakeholders of the impending activation of ATFM measures and of ATFM (and A-CDM) information such as CTOT, TSAT, TTOT?**

- **Stuart Ratcliffe:** There are different messages and processors used throughout the world. The Network Manager in Europe uses a specific set of messages to communicate ATFM measures. ATS messages and Operational Information Systems (OIS) are used in other parts of the world, as are e-mail messages. Many ATFM systems also have web-based portals where ATFM measure information and CDM processes are available.
- **Dan Schuller:** In Europe - partly within SESAR research - the benefits of sharing locally identified hotspots before ATFM action is implemented is a clear need, as it allows airspace users to refile if they cannot accept delay for priority flights. For ANSPs it delivers benefit through a more stable network as reactive action by AUs to no-notice ATFM measures is reduced. B2B connectivity with the network coordinator (NM) and a toolset a local level to both receive/display and output local hotspots is essential at ANSP level, and for AUs - capability to identify their flights within hotspots.

Current day there may be no pre-notice of a regulation, the network will be aware only when the measure is requested and applied. If applied within 2 Hrs of EOBTs - this will also see slot messages issued for affected flights, and pre-allocated slots for flights more that EOBT-2hrs.

**Q: To avoid inadvertent underutilization of available capacity when an ATFM measure (such as GDP) is activated, has any ATFM unit/center set their capacity parameter to be slightly higher than the expected capacity? This can help reduce ATFM delay and keep the pressure on the available capacity, though may create congestion and airborne holdings.**

- **Stuart Ratcliffe:** Yes, “raising the rate” is a fairly common technique, and often effective, since ATFM measures tend to under-deliver slightly. The key is to apply post-operations analysis to assess the amount of systematic under-delivery (if it exists), and then compensate for it when setting the ATFM measure rate. Over-delivery is also possible, e.g. when there are popup flights, and can be compensated for by adding some open slots to be assigned later.

**Q: In the case where a flight subjecting to ATFM delay, e.g. assigned a CTOT, has to also adhere to an additional constraint at the destination airport such as airport closure, what can be done to help that flight?**

- **Stuart Ratcliffe:** In an environment where ATFM is done from a central point (FAA/Network Manager), the ATFM system will have the ability to exempt the flight from one or more of the ATFM measures it could be subjected to. It becomes a lot more complex in a Multi-Nodal environment where ATFM is not done from a central point (APAC). An aircraft could be subject to multiple ATFM measures in FIRs it is flying through, particularly where ANSPs are using different ATFM systems. This issue is under discussion on how to manage and until there is full connectivity between ATFM systems employed by ANSPs, it has been agreed that CDM between ANSPs will take place and agreement will be reached on which ATFM measure the flight will be subject to.

**Q: How can ATFM be used to help improve traffic sequencing during the tactical ATS phase?**

- **Stuart Ratcliffe:** An AMAN system is a significant assistance to controllers in sequencing traffic, however if the arrival rate for an airport is set at 30 aircraft an hour in the AMAN system and 40 aircraft arrive in the TMA in an hour, then the AMAN will more than likely place the extra 10 aircraft into airborne holding. ATFM assists in this instance by creating either a GDP or AFP which will be set to deliver 30 flights an hour which will prevent the airborne holding. In an environment where there is no AMAN, ATFM can also deliver the required arrival rate to TMA or aerodrome ensuring that the ATC is not overloaded in the tactical phase. Another example where ATFM will assist with either departure or arrival flights is through fix-balancing.

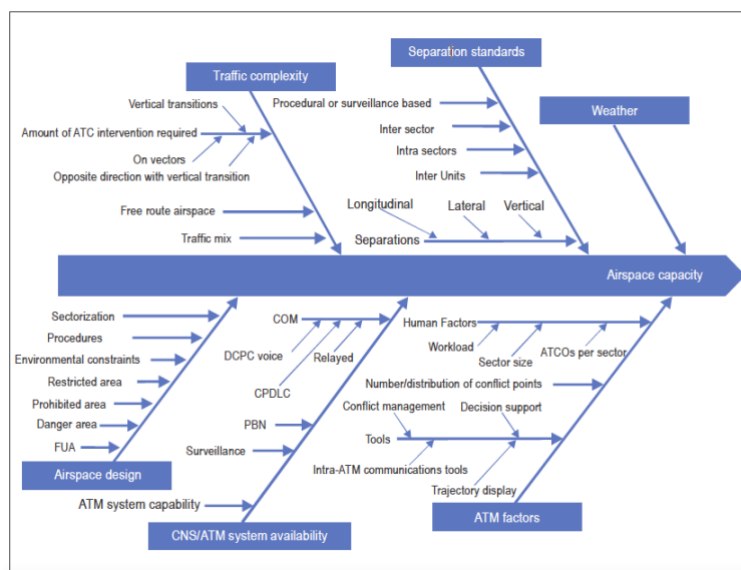
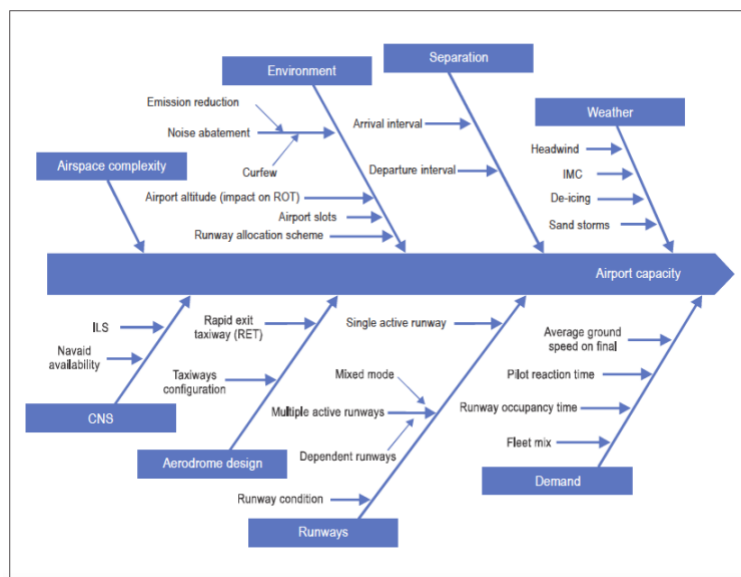
**Q: What strategies can be used to reduce radar vectoring?**

- **Stuart Ratcliffe:** To answer the question we first need to ask a question, what is the cause of excessive radar vectoring? It could be because the SIDs, STARs, airspace, or procedures are badly designed and ATCs have to vector traffic for positioning, sequencing, and separating. Of course, this is resolved by better design. In some ANSPs, the ATC culture is to vector traffic and not to leave flights on the published procedures. This is resolved by training and regulations to ensure compliance with published procedures. I have seen some TMAs where it is not possible to have holding patterns so the only way the controllers can sequence traffic is by excessive vectoring. This can be resolved by ATFM procedures delivering a flow of traffic that is consistent with the capacity of the airspace, reducing or eliminating the requirement to do excessive vectoring.



**Q: Given that there are multiple factors impacting – and constraining – resource capacity, can ATFM effectively consider all these constraints to provide an optimal outcome?**

- **Stuart Ratcliffe:** The ATFM measure will be effective to the degree that it incorporates accurate forecasts of resource capacities. When there are multiple factors constraining capacity, this can be very challenging. Effective ATFM training will teach flow managers to consider all factors impacting constraints, The fishbone diagrams in Part II, Chapter 3 of ICAO Manual on Collaborative ATFM (Doc 9971) (shown below) shows some of the factors a flow manager should consider when setting capacity. While it could be considered a science, the variables and the ability for circumstances to change quickly and dramatically makes this demand prediction challenging. There is a demand from ANSPs for decision support tools, which do exist, to assist with this decision-making process.



## Organization-Specific Questions

### NATS

**Q: To fill the gap between planned and actual flight data, has NATS and/or the European Network Manager - in the context of SESAR - invented tools to mitigate this weakness?**

- **Dan Schuller:** The SESAR programme had identified this as one of three topics to be pursued in the current research period. However, COVID has intervened and we no longer have this within the programme; but I believe EUROCONTROL (Network Manager) will continue to work on it independently. The problem of improving demand prediction in the pre-tactical phase (primarily at D-1), and also the transition of this prediction into the tactical day, is very real and the cause of inefficiency for most stakeholders.

The view of the evolving demand is from initial flight data predictions, followed by preliminary FPL, later by FPL /eFPL, the network demand picture is created, updated and refined in a rolling and dynamic process. The dynamic process is important as the two datasets (forecast and actual) will not have a direct correlation, and the qualification of the demand as it transitions between the two states is in terms of certainty.

As to how concrete these plans are - well, this is still in research, with both Big Data and AI noted as innovative technologies required. So it may take some while for the full capability to be incorporated into NM Systems. But I fully anticipate a stepped approach with some new functionality incorporated relatively easily. An example here is early flight plans which can be filed up to 6 days in advance will not be loaded into the predictive tool (PREDICT) until EOBT-40hrs.

NATS uses NM demand data extensively in planning as a service. Our planners will model various capacity scenarios in pre-tactical and use their expertise and supporting post ops data to attach a level in confidence to the forecast demand. They can access the NATS ACC data to provide information on sector combinations and timings, but we do not have any NATS-specific tools that can attach a level of certainty/confidence to the forecast. In this respect we are very dependent on human expertise.

**Q: Which data sources are used to analyze daily operations? Do you use B2B data from the Network Manager (i.e. Traffic Count, Flight List, Traffic Demand, Traffic Load, Regulated Demand)?**

- **Dan Schuller:** For the tactical operation, we use a mix of data to feed two tools. The connectivity with NM to view entry/occupancy counts against TFVs is via B2C, with B2B still in future. The lack of B2B does not affect our ability to analyse, but we obviously cannot interact with all available functionality until we take this step.

Tactical users will use our legacy predictive system for occupancy, which uses both NM data (via AFTN server) and external inputs (although most of these external inputs have gradually been incorporated into NM data) plus data direct from FDP.

This legacy tactical tool (TLPD) is close to end of life and will see a new system (iACM developed with Indra) utilising the iTEC trajectory to reflect the ATC intent more accurately. It will therefore use an FDP data with NM data also (with B2B).

For decision making for regulation - SIMEX is very useful and now accurate for the tactical operation as it is connected to the CASA algorithm. In the operation, the actual rate/60, start and end times, plus precisely which TFV to regulate - we are still very dependent on expertise of the FMP staff. We also have an optimisation tool under development, which - if successful - should provide system support for regulation rate using post ops data.

**Q: Is your regulator from the national transport ministry or from the regional (EU) level?**

- **Dan Schuller:** The [UK Civil Aviation Authority](#) is NATS' regulator, and they use the EU's performance targets and reference periods as a framework on which to set national performance targets for the UK and for NATS. We are ultimately responsible to the CAA who legally enforce our license obligations.

**Q: In counting your traffic (entry & occupancy counts), do you take into account "airspace avoiders" (filed but did not show up) and "airspace intruders" (not filed but showed up) as well?**

- **Dan Schuller:** Whilst we use ETFMS and the intruder functionality to highlight which flights are/were extra, tactical users close to execution itself will be using NATS' legacy tool which will simply display what is coming and will not differentiate between what should/should not be there. This question actually highlights the subtle difference between some FDPS (both our legacy one and planned one) which may process vertical profiles differently to that filed and profiled with NM systems. We will give priority to the data from the FDP when close to execution as it displays ATC intent (irrespective as to whether it fully respects the FPL) as this is the demand that will have to be managed.

**Q: Are there agreements in place to obtain operational data from adjacent ANSPs regarding flights that are managed by ATFM restrictions?**

- **Dan Schuller:** For NATS, this is not really a need, as the data is collected and available via the regional network coordinator based in Brussels (EUROCONTROL - acting as Network Manager). We will use our own operation data derived from FDPS where needed to give additional detail where needed, but for ATFM purposes and calculation of delay and attribution to whoever was responsible for delay - the NM data service is more than adequate.

## [Airservices Australia](#)

**Q: Does your ATFM system allocate ATFM slots to international flights as well, or does the system only focus on domestic flights?**

- **Daniel Schauries:** We currently only assign ground delay to domestic flights, in the Australian context these are flights with typical flight times between 1 and 4 hours. International flights are allocated an ATFM slot based on their scheduled time of arrival but are exempt from being assigned any ground delay. Apart from challenges associated with having the jurisdiction to assign and enforce ground delay in other FIRs, the flight time is a key constraint on implementing ground delay for long-haul flights, as many flights are already airborne by the time an ATFM program is run. As an alternative, we are, however, exploring ATFM measures on long-haul through Long Range ATFM.

**Q: Does Airservices provide a suggested target time at the 250 NM boundary for incoming aircraft to smooth the arrival flow and holding?**

- **Daniel Schauries:** No, the 250NM radius is chosen for analysis purposes only, and represents the horizon from where the tactical arrival manager begins assessing aircraft ETAs for the destination airport. Subsequent holding and delays are typically managed within that radius through speed control, vectoring and other measures.

## [FAA](#)

**Q: Why do inaccurate EETs in the flight plans result in inaccurate CTOT calculations?**

- **Vern Payne:** Inaccurate EETs in the flight plans result in inaccurate traffic demand prediction. The inaccurate demand prediction then begets inaccurate plan and calculation of ATFM measures such as CTOTs (EDCTs), as they are calculated based on the flight profiles derived from information in the flight plans. With an inflated EET as the basis of the CTOT calculation, once airborne, the EETs are updated and arrival demand shifts time buckets. The final result is uneven delivery in the GDP and often leads to ground stops and revisions to the GDP. We initially only looked at those flights in the initiative/regulation, now we are looking at all flights, trying to understand how to improve overall demand prediction, both at arrival airports as well as enroute.
- **Stuart Ratcliffe:** Adding to Vern's comment, calculated take-off time (CTOT) is back-computed from the calculated runway arrival time (CLDT). For instance, if the desired arrival time is 1359z, and the EET is 2 hours, then the CTOT should be 1159z. But this means that any error in EET will lead to an error in CTOT. Fortunately, in ATFM, most of these effects are drowned out or cancelled by other stochastic effects. For instance, one flight may arrive a few minutes early, but another one may arrive a few minutes late. Provided that the overall flow to the affected resource (e.g. an airport) is about right, the ATFM measure should meet its overall objectives. But post-operations analysis should be conducted to see if this is the case. If the

overall net effect is not achieved and if the EETs are seen to be inaccurate, actions should be taken to resolve the issues.

**Q: How do you determine that the inaccuracies of EETs are due to erroneous filing by the airlines, as opposed to - e.g. - ATC actions on the flights while they are enroute?**

- **Vern Payne:** Part of our data set is a historically calculated EET. This is derived as follows:
  1. Looking back 168 hours (7 days) of flights between the city pair
  2. By the flight operator
  3. By the type of aircraft flown

Now that the historic data set is defined, the route of flight, altitude and actual take off time to actual touchdown time are calculated. The altitude, route and EET of 51% of the data set is used for demand prediction until the flight operators submit updated information for the flight. There is a CDM “Early Intent” message that the operators can use to advise of intentions before filing a flight plan. Then the flight plan is filed and that data is used. Next, the flight departs and our system starts to calculate an updated arrival time and continues to update that until the flight completes.

Comparing the historic calculated EET and the actual EET with what the airlines are submitting in early intent messages and flight plans shows us that the airline-supplied EET varies during the day and is often substantially greater than actual. Substantially less often, the airline-supplied EET is less than the historic/actual EET.

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