Tactical Surface Metering Procedures for Charlotte Douglas International Airport

AHFE
July 25, 2018

Savvy Verma, William J. Coupe, Hanbong Lee, Isaac Robeson, Yoon Jung, Shivanjli Sharma, Vicki Dulchinos, Lindsay Stevens
Outline

- Motivation
- Objective
- Surface metering Tool
- Metering Procedures
- Analyses & Feedback
- Summary
• Airport congestion leads to delays and loss in predictability
• NASA is testing tools to address the problem
  – Spot and Runway Departure Advisor (SARDA) (Jung, Malik, Gupta & Hayashi, 2014)
  – Gate hold times and runway queues were explored in a Human-In-The-Loop (HITL) (Verma et al., 2017)
• NASA deployed ATD-2 tools that included a Tactical Surface metering Tool at Charlotte Douglas International Airport (CLT) in Sept 2017
• The surface metering procedures were required for deployment of the tool

ATD-2 = Airspace Technology Demonstration-2
Objective

- Define metering procedures for deployment of surface metering at Charlotte Douglas International Airport (CLT)
- Obtain user feedback and perform initial analysis to improve the metering tool and procedures
Surface Metering Tool at CLT

- Gate Pushback Schedule
- Spot Release Schedule
- Runway Schedule
Surface metering is analogous to ramp metering at freeways

- Recommends gate hold times based on pushback advisories
- Calculates pushback advisories or Target pushback times as follows:

\[
\text{Target Pushback Time} = \max \left[ \text{Ready Time}, \text{Target Take Off Time} - \text{Unimpeded time} - \text{TargetExcessQueueTime} \right]
\]
Metering Advisories on Ramp Controller Tool

- **Push Advisory**
  - Ready Time < 10 min

- **Gate Hold Advisory**
  - Ready Time < 10 min
  - 4 min

- **Hashtag: Click here to get an advisory**
  - Ready Time > 10 min

Metering Tool
Surface metering procedure at CLT is a collaborative function shared by ATC-T Traffic Management Coordinator (TMC) and Ramp Manager.

Coordination was required for decisions that included:
- Turning metering on and off
- Setting parameters
  - Target excess queue time/gate holds
  - Thresholds for displaying advisories

Metering Procedures
Metering Procedures

1. Coordinate over phone to decide whether to start metering procedures and utilize metering tool.

2. Explore Predicted AMA Excess Queue Time and Gate Holds using Metering-What-If DASH.

3. Select Target AMA Excess Queue Time using DASH together over phone.

4. Ramp Manager enters values selected collaboratively into Operational RMTC.

5. Both receive notification on different clients.
Metering Procedures

1. Coordinate over phone to decide whether to start metering procedures and utilize metering tool.

**Source: Author’s photographs**
Explore Predicted Excess Queue Time in the Airport Movement Area (AMA) and Gate Holds using What-If DASH.

ATC Tower  DASH  Airline Ramp Tower

DASH=Data Analysis System Health
Data Analysis and System Health (DASH)  
Target = 10

Users explored different targets and thresholds and when metering will get triggered
Data Analysis and System Health (DASH)

Target = 12

Metering Procedures
Runway View - Target as 14

No advisories will be displayed here because the peak is below the upper threshold.
3. Select Target Excess Queue Time using DASH together over phone.
Ramp Manager enters values selected collaboratively into Operational Ramp Manager’s Traffic Console.
Ramp Manager
Set Metering Mode to Time Based Metering from Tools Menu
Set Target AMA Excess Queue Time

14 minutes
12 minutes
10 minutes
Other: 5 minutes.
Justification: test1

Metering Display Threshold
Turn metering on when excess queue time rises to: 16 minutes.
Turn metering off when excess queue time drops to: 12 minutes.
5

Everyone receives notification on their respective clients.
Notification of Time Based Metering

Metering Procedures
Metering Procedures

1. Coordinate over phone to decide whether to start metering procedures and utilize metering tool.

2. Explore Predicted AMA Excess Queue Time and Gate Holds using Metering-What-If DASH.

3. Select Target AMA Excess Queue Time using DASH together over phone.

4. Ramp Manager enters values selected collaboratively into Operational RMTC.

5. Both receive notification on different clients.
Initial Feedback and Analysis
Data Collection at CLT

CLT in North Configuration

Data collected from operational system from 9:00AM to 11:00AM between 2017-11-29 and 2018-01-28
Feedback and Observations

• Metering was triggered early and the users had to wait to pushback the flights
• Users were suggested to increase the Target thresholds or Target Excess Queue Time so that metering was triggered later in the bank
• The number of flights impacted by metering was high and users were not holding them back
• Also the users did not hold the flights for the entire recommended gate hold time
Preliminary Analysis and Feedback

• Metering was triggered early and the users had to wait to release the flights
• Users were suggested to increase the Target thresholds or Target Excess Queue Time so that metering was triggered later in the bank
• The number of flights impacted by metering was high and users were not holding them back
• Also the users did not hold the flights for the entire gate hold recommended by the tool
Metering triggered too early (36R)

Preliminary Analysis

Change in metering algorithm to include active flights

Metering caused flights to be held back when there were few/no flights in the AMA
Preliminary Analysis and Feedback

• Metering was triggered early and the users had to wait to release the flights
• It was suggested that users increase the Target thresholds or Target Excess Queue Time so that metering would be triggered later in the bank
• The number of flights impacted by metering was high and users were no holding them back
• Also the users did not hold the flights for the entire gate hold recommended by the tool
Target Thresholds Set by Users (North Flow)

Metering procedures were adjusted here to enter higher upper thresholds

Preliminary Analysis
Preliminary Analysis and Feedback

- Metering was triggered early and the users had to wait to release the flights
- Users were suggested to increase the Target thresholds or Target Excess Queue Time so that metering was triggered later in the bank
- The number of flights impacted by metering was high and users were not holding them back
- Also the users did not hold the flights for the entire gate hold recommended by the tool
Flights Subjected to and held for Metering (North Flow)

Percent of flights that were held was about 50-60%
Preliminary Analysis and Feedback

- Metering was triggered early and the users had to wait to release the flights
- Users were suggested to increase the Target thresholds or Target Excess Queue Time so that metering was triggered later in the bank
- The number of flights impacted by metering was high and users were no holding them back
- Also the users did not hold the flights for the entire gate hold recommended by the tool
Recommended Gate hold times and Realized holds (North Flow)

A few aircraft had high recommended gate hold times since flights called well before their ready time.

Mean Advisory (target-ready)

Mean Realized Hold (push-ready)

Holding aircraft at the gate is a paradigm shift for the users.

Preliminary Analysis
Surface metering procedures were defined for deployment.

Initial analysis and feedback allowed improvement of the surface metering algorithm:
- Surface metering algorithm used expected traffic instead of actual physical queue, which led to many issues revealed earlier.

To hold flights for surface metering is a shift in user’s paradigm:
- Training can facilitate the understanding of gate hold times as compared to ready times.
- High gate holds have several factors and one of them was flights calling much earlier than their estimated ready time.

Future work continues to explore compliance to pushback times as compared to spot times.