Taxi Time Comparison
Before and After Surface Metering
Using ASPM data

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Executive Summary

- In this taxi time analysis, the ASPM data before and after surface metering were compared to see the effects of surface metering on taxi-out/in times. Since the surface metering turned on only in Bank 2 (the second peak time at CLT, usually between 9am and 11am), the taxi-out times of departures in Bank 2 were first compared, with different data groups to exclude EDCT flights and/or taxi time outliers.
- According to the overall comparisons, there was no significant difference on taxi-out times between pre- and post-metering datasets both within Bank 2 and beyond Bank 2. When the definition for Bank 2 changed from OUT times to OFF times, the results were same. These results mean the departure traffic volume did not change between two time periods, and the surface metering did not affect the total taxi-out times.
- For arrivals, the mean taxi-in times increased in ’17-18 regardless of peak times, but it seems that this increase came from the increased arrival traffic volume.
- In conclusion, therefore, the surface metering from ATD-2 technologies at least did no harm in taxi-out times at CLT. Considering that the gate holdings from pushback advisories were included in the total taxi-out times, the actual taxi times might be reduced by gate hold times.
- Since this analysis was done only for the early days after the surface metering had turned on, more detailed data analyses should be conducted for overall evaluation in the future, including the effects on other airport performance metrics such as runway throughput, takeoff time predictability, queue size, and environmental benefits.

Contents

Introduction

- Motivation
  - ATD-2's surface metering has turned on at Charlotte Douglas International Airport (CLT) since November 29, 2017.
  - It is expected that the surface metering can improve efficiency and mitigate congestion on the airport surface during peak times by holding departures at gates, instead of waiting in departure queues.
  - It is required to quantify the effects of surface metering on airport performance and show the operational benefits by comparing the taxi time data before and after surface metering.

- Objectives of taxi time comparison
  - To ensure the ATD-2's surface metering at least does no harm in airport performance represented by taxi-out/in times
  - To check if there are any effects of surface metering on taxi times in the initial deployment phase at CLT field

ASPM Data

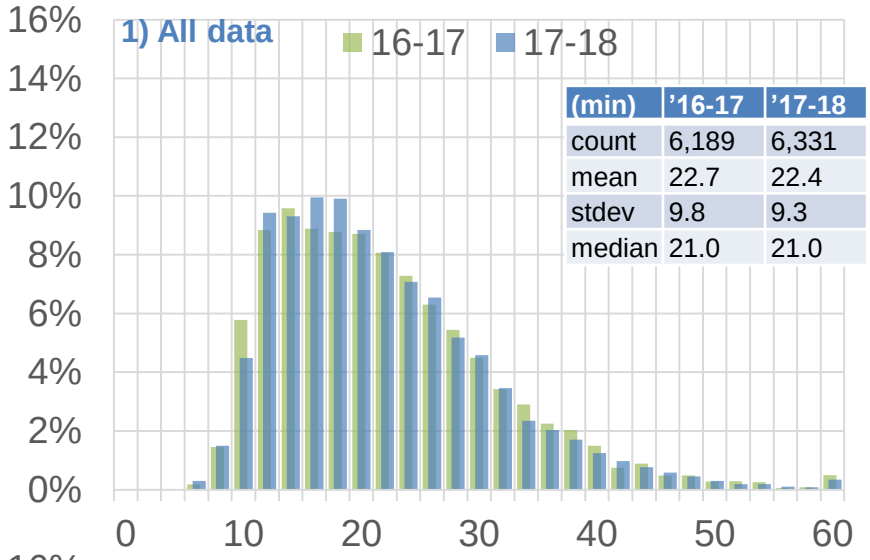
- Data ranges (total 82 days)
  - Selected Aviation System Performance Metrics (ASPM) data in exactly same dates before and after surface metering
    - To make apples-to-apples comparison and remove seasonal effects
  - Dataset 1: 11/29/2016 – 2/18/2017 for Pre-metering
  - Dataset 2: 11/29/2017 – 2/18/2018 for Post-metering
    - Surface metering turned on for bank 2 only during this time period
- Data filtering
  - Excluded the following 10 days when surface metering was not turned on (or not applied) in both datasets
    - 12/9, 12/26, 12/27, 1/10, 1/11, 1/15, 1/17, 1/18, 2/4, 2/17
  - Bank 2 definition used in this analysis
    - 1) Actual out (T_OOOI_DEP) for departures: 0900 ~ 1030
      - Note that ACARS OUT times can be inaccurate.
    - 2) Actual off (T_WHLS_OFF) for departures: 0900 ~ 1100
    - Actual on (T_WHLS_ON) for arrivals: 0900 ~ 1100
  - Considered EDCT flights (EDCT_OFF) as well

Comparison Methods

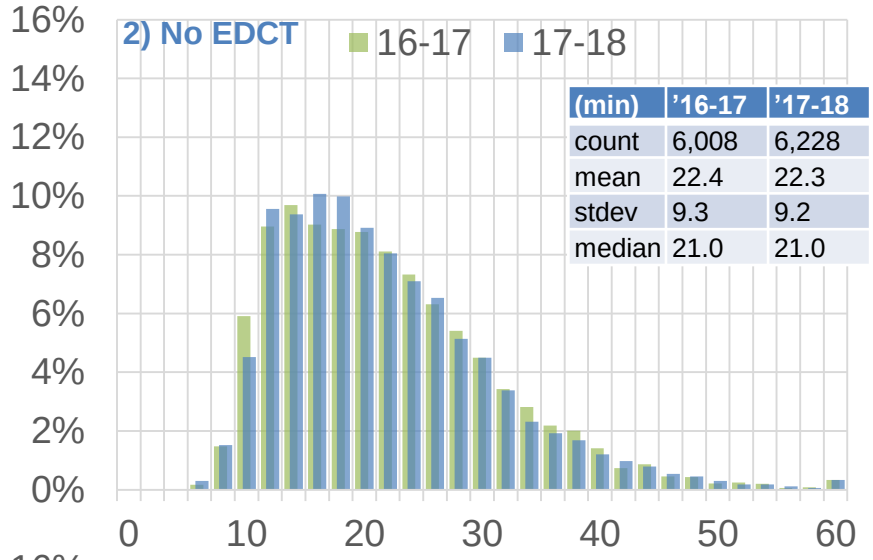
- Metrics
  - Total taxi-out times for departures (OFF – OUT)
  - Total taxi-in times for arrivals (IN – ON)
- Data groups for comparison between ’16-17 and ’17-18 data
  - Departures in Bank 2 based on OUT times
    - All data (include EDCT flights)
    - No EDCT flights
    - No EDCT flights, 5min <= taxi time <= 60min (exclude outliers)
    - EDCT flights only
  - Departures beyond Bank 2 based on OUT times
  - Departures in Bank 2 based on OFF times
  - Departures beyond Bank 2 based on OFF times
  - Arrivals in Bank 2 based on On times
  - Arrivals beyond Bank 2 based on On times

ASPM Taxi Time Comparison: Departures in Bank 2 (OUT: 9-10:30am)

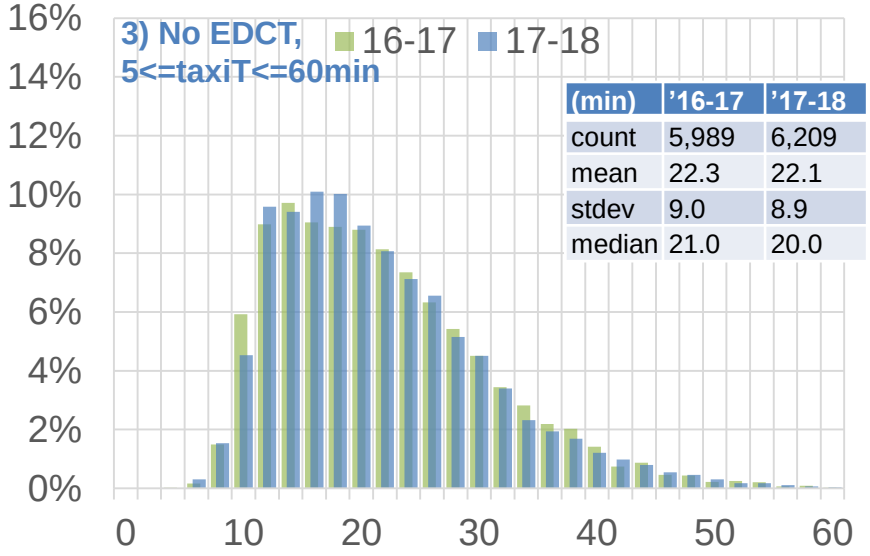
There is no significant difference on taxi-out times between pre- and post-metering datasets, although there is a little improvement with surface metering when excluding EDCT flights and taxi time outliers.



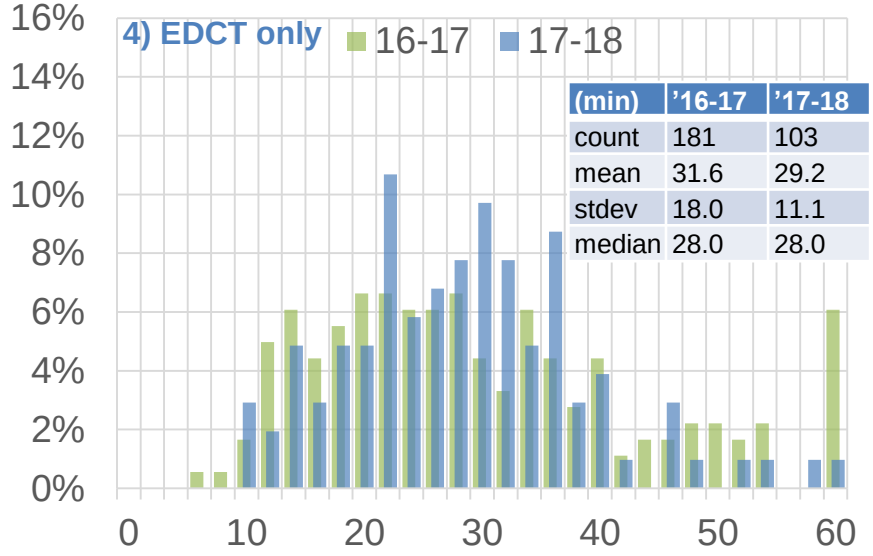
(min)	'16-17	'17-18
count	6,189	6,331
mean	22.7	22.4
stdev	9.8	9.3
median	21.0	21.0



(min)	'16-17	'17-18
count	6,008	6,228
mean	22.4	22.3
stdev	9.3	9.2
median	21.0	21.0



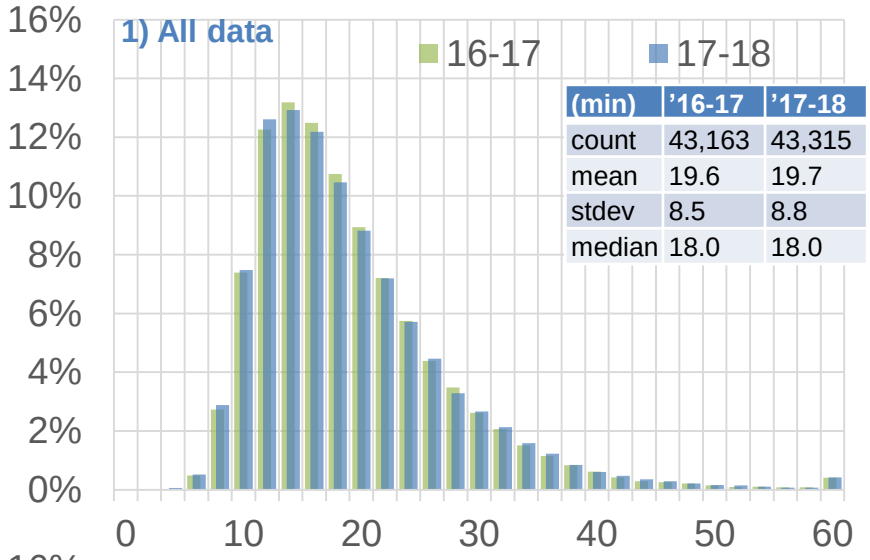
(min)	'16-17	'17-18
count	5,989	6,209
mean	22.3	22.1
stdev	9.0	8.9
median	21.0	20.0



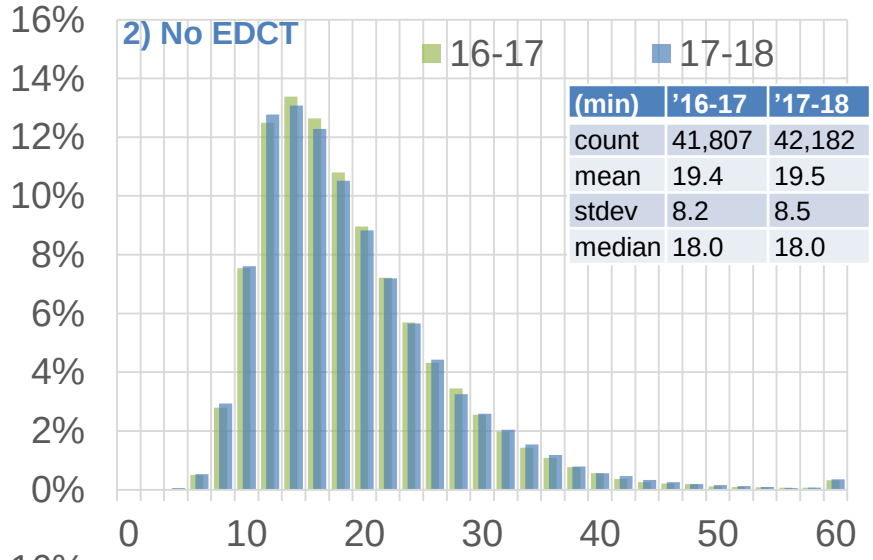
(min)	'16-17	'17-18
count	181	103
mean	31.6	29.2
stdev	18.0	11.1
median	28.0	28.0

ASPM Taxi Time Comparison: Departures beyond Bank 2 (OUT: <9 | >10:30)

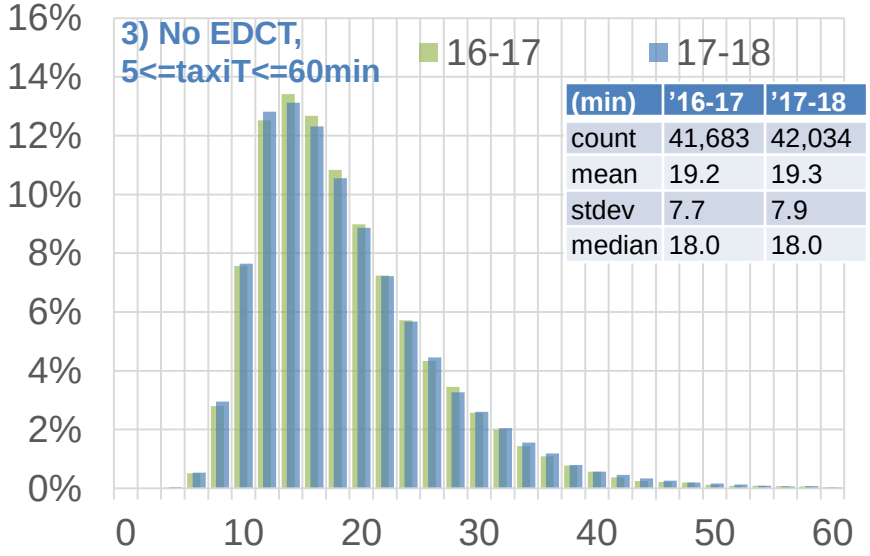
There is no significant difference on taxi-out times between pre- and post-metering datasets beyond Bank 2, showing daily traffic pattern and volume didn't change after metering turned on.



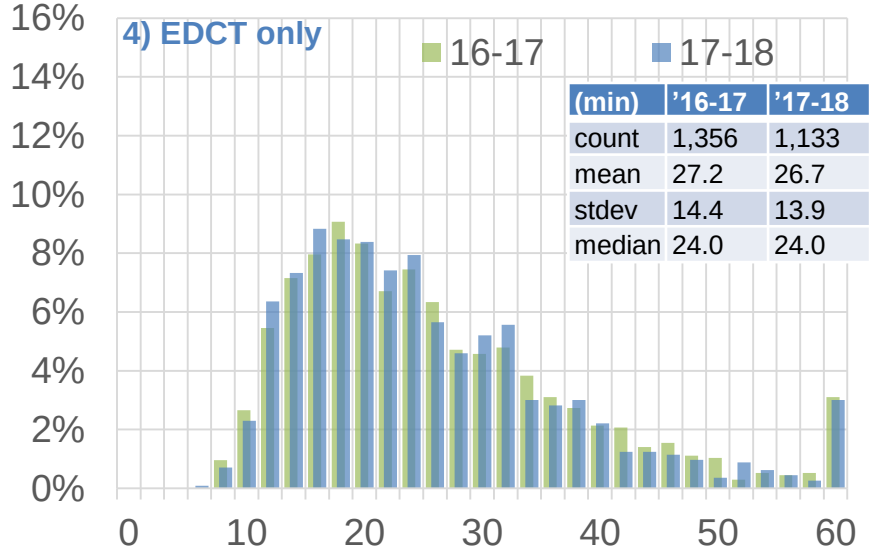
(min)	'16-17	'17-18
count	43,163	43,315
mean	19.6	19.7
stdev	8.5	8.8
median	18.0	18.0



(min)	'16-17	'17-18
count	41,807	42,182
mean	19.4	19.5
stdev	8.2	8.5
median	18.0	18.0



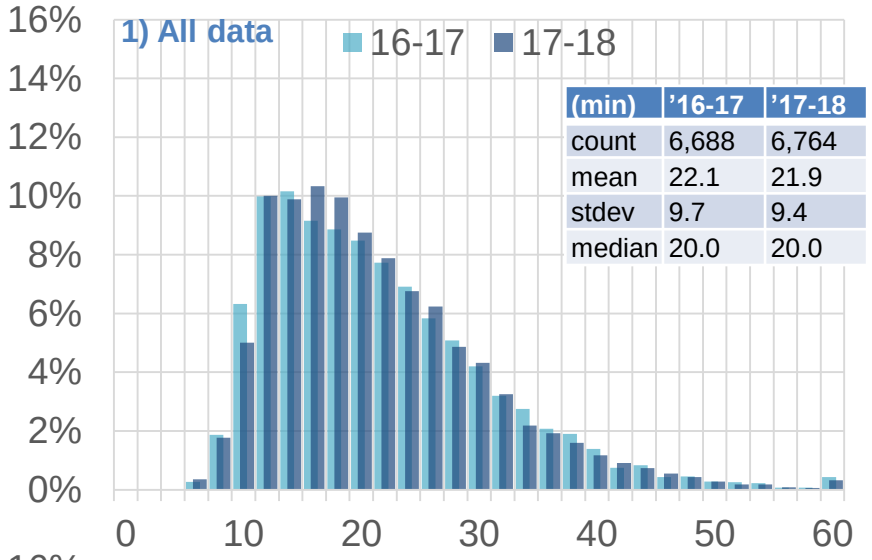
(min)	'16-17	'17-18
count	41,683	42,034
mean	19.2	19.3
stdev	7.7	7.9
median	18.0	18.0



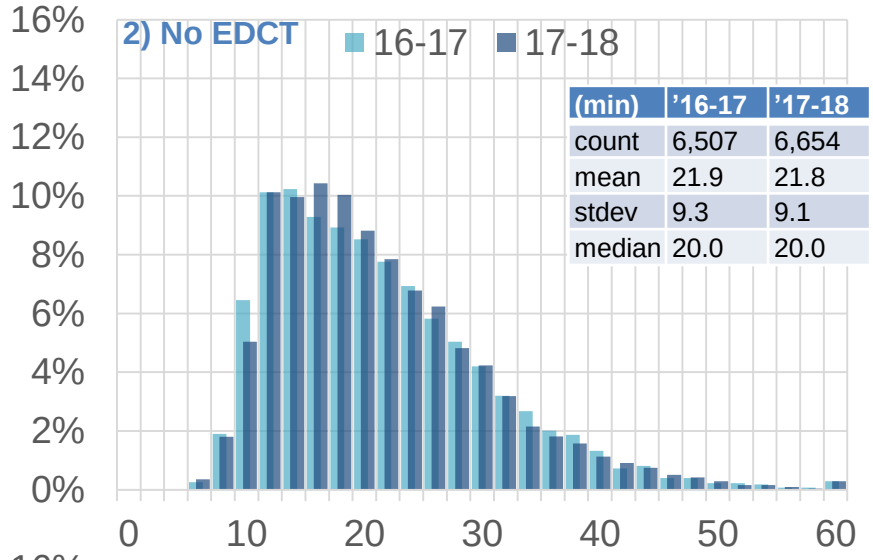
(min)	'16-17	'17-18
count	1,356	1,133
mean	27.2	26.7
stdev	14.4	13.9
median	24.0	24.0

ASPM Taxi Time Comparison: Departures in Bank 2 (OFF: 9-11am)

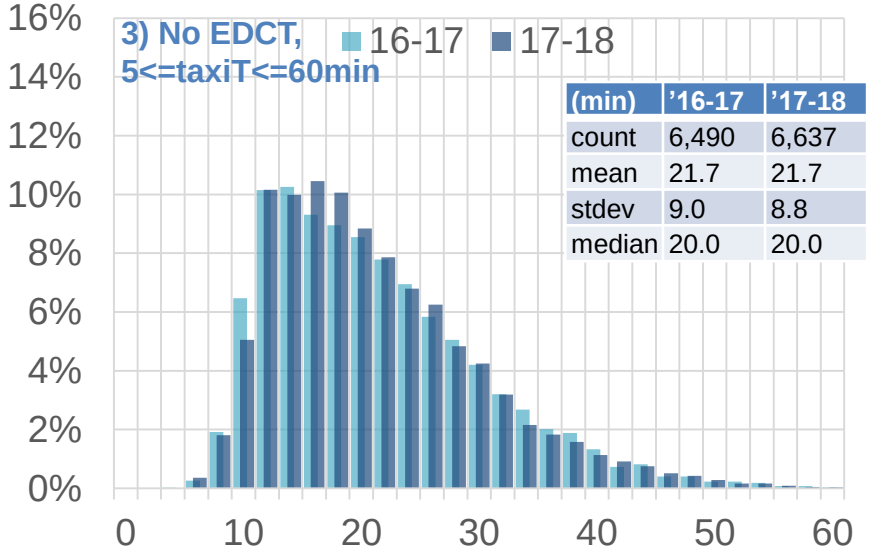
There is no significant difference on taxi-out times between pre- and post-metering datasets in Bank 2 based on takeoff times, which include more departure flights.



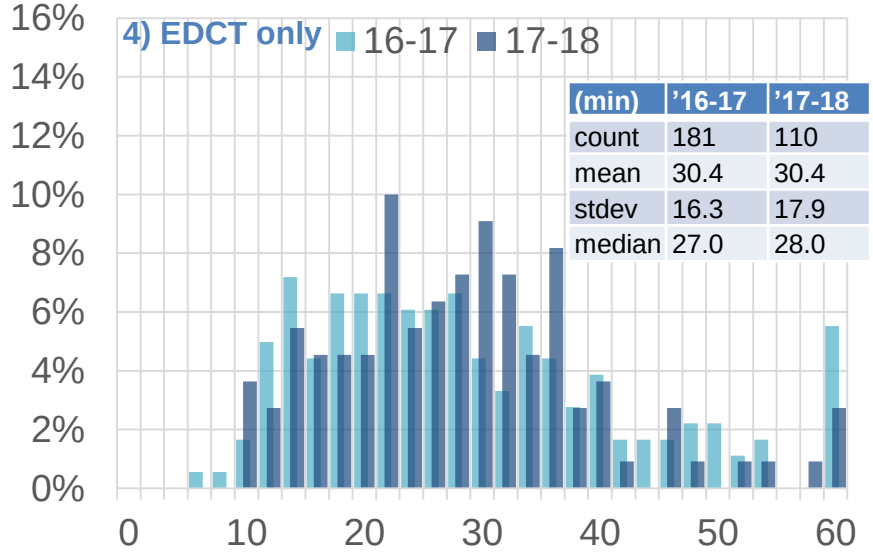
(min)	'16-17	'17-18
count	6,688	6,764
mean	22.1	21.9
stdev	9.7	9.4
median	20.0	20.0



(min)	'16-17	'17-18
count	6,507	6,654
mean	21.9	21.8
stdev	9.3	9.1
median	20.0	20.0



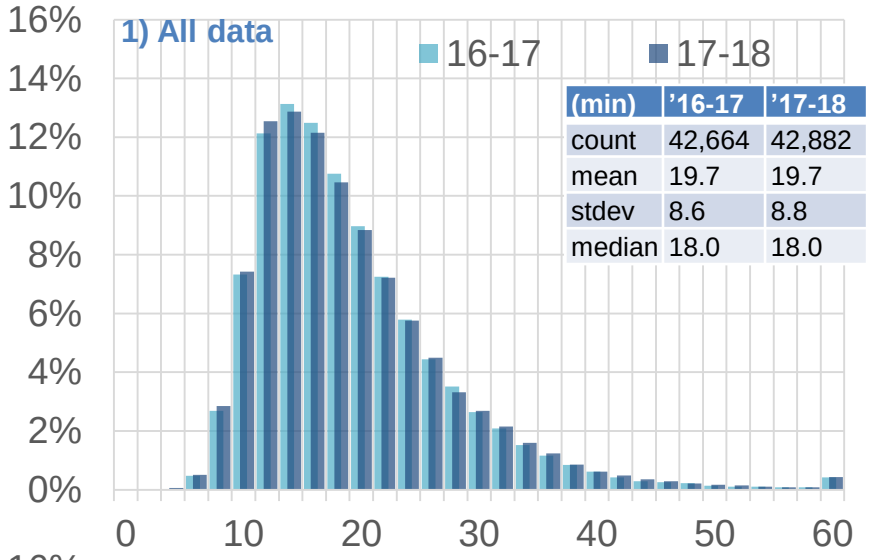
(min)	'16-17	'17-18
count	6,490	6,637
mean	21.7	21.7
stdev	9.0	8.8
median	20.0	20.0



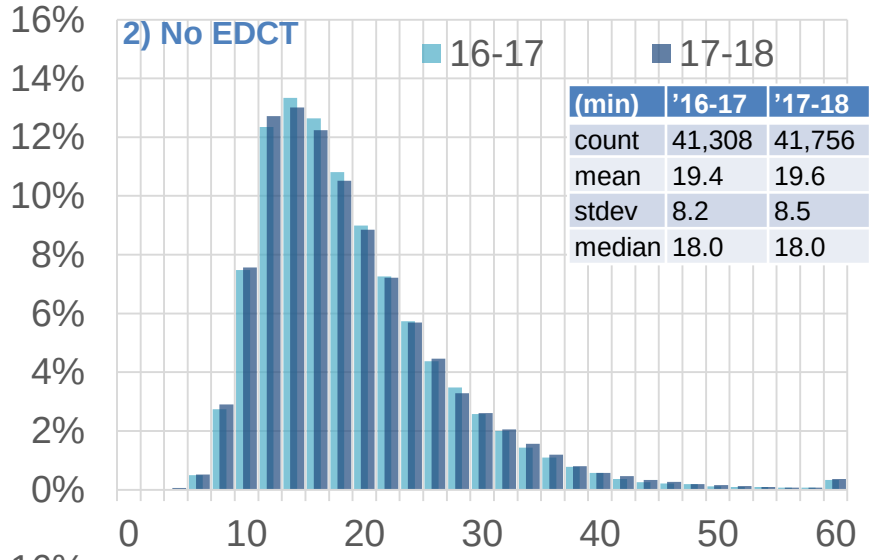
(min)	'16-17	'17-18
count	181	110
mean	30.4	30.4
stdev	16.3	17.9
median	27.0	28.0

ASPM Taxi Time Comparison: Departures beyond Bank 2 (OFF: <9 | >11)

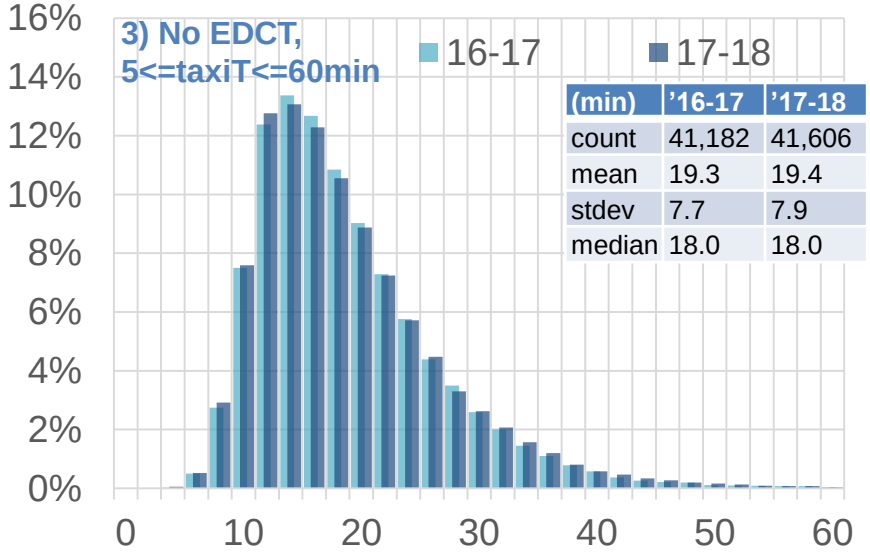
There is no significant difference on taxi-out times between pre- and post-metering datasets not in Bank 2 based on takeoff times, for the flights that took off before 9am or after 11am.



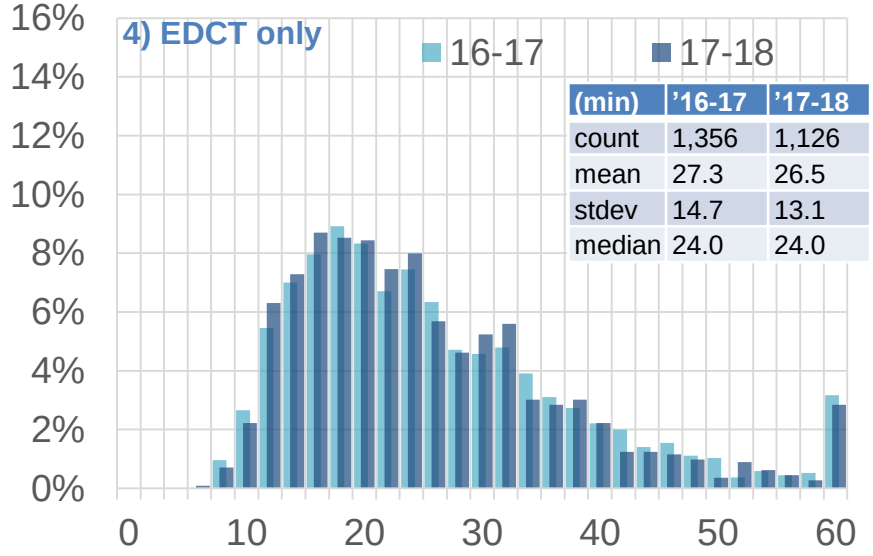
(min)	'16-17	'17-18
count	42,664	42,882
mean	19.7	19.7
stdev	8.6	8.8
median	18.0	18.0



(min)	'16-17	'17-18
count	41,308	41,756
mean	19.4	19.6
stdev	8.2	8.5
median	18.0	18.0



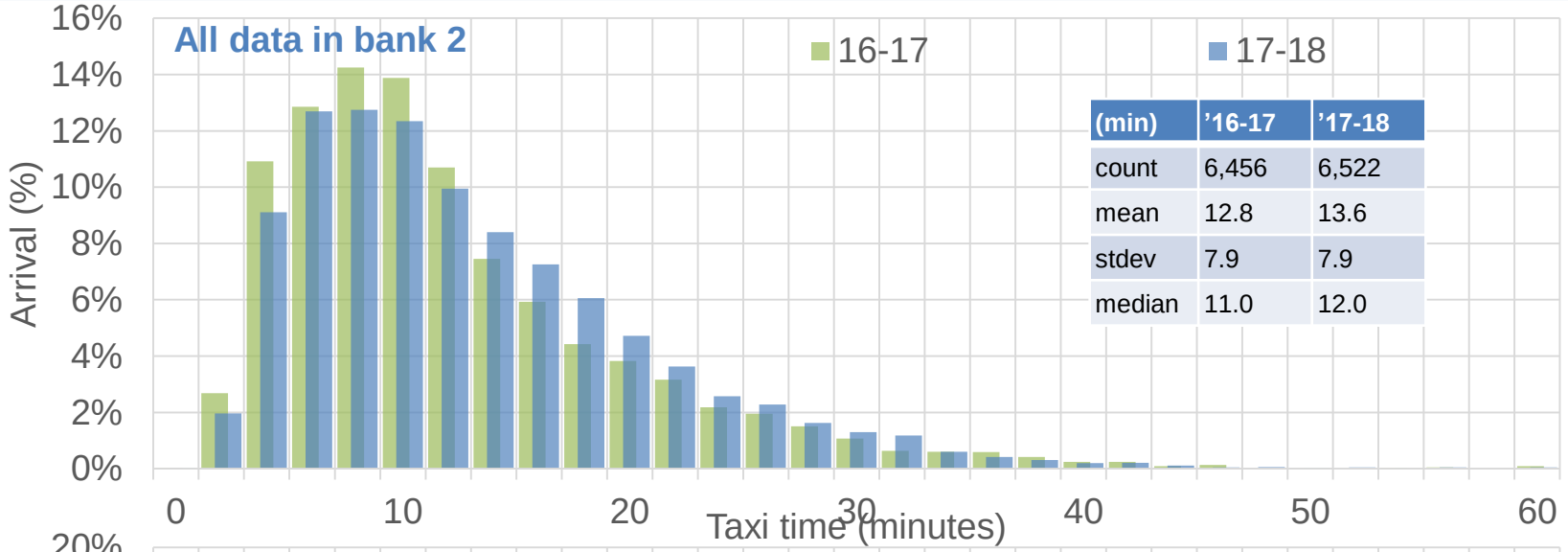
(min)	'16-17	'17-18
count	41,182	41,606
mean	19.3	19.4
stdev	7.7	7.9
median	18.0	18.0



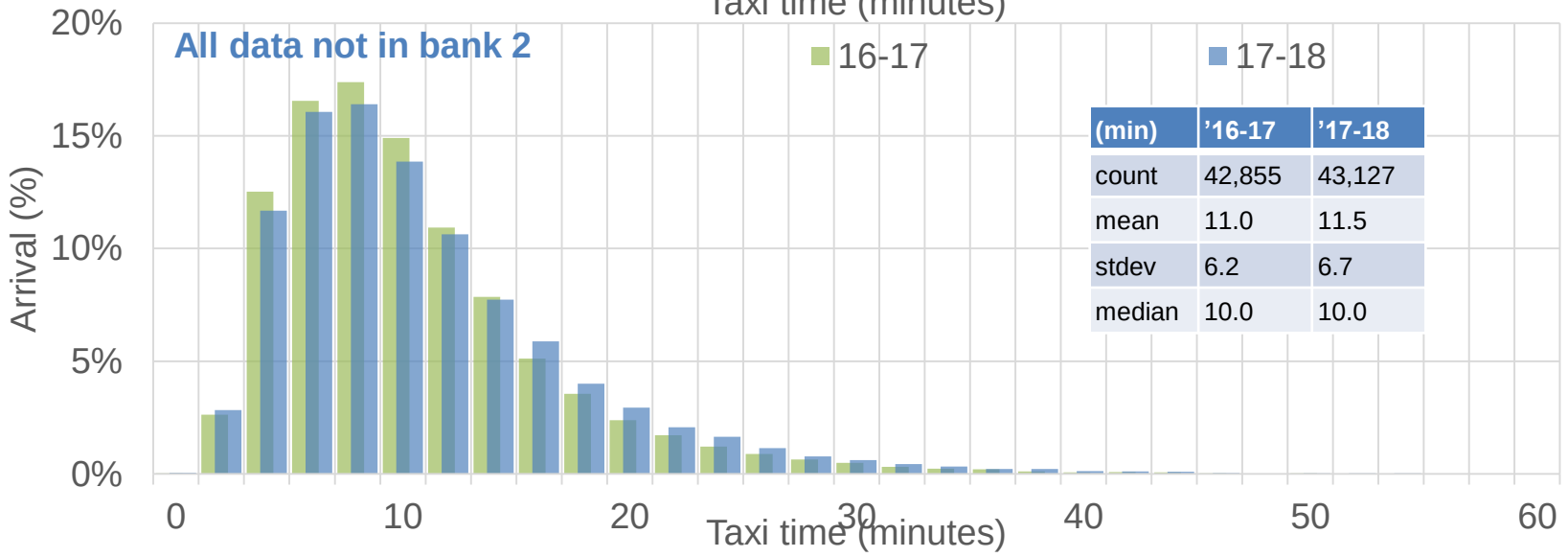
(min)	'16-17	'17-18
count	1,356	1,126
mean	27.3	26.5
stdev	14.7	13.1
median	24.0	24.0

ASPM Taxi Time Comparison: Arrivals in Bank 2 and Others

The mean taxi-in time increased after metering turned on, but the increases occurred both in bank 2 and beyond bank 2. That means this change may come from other factors like arrival traffic volume increase.



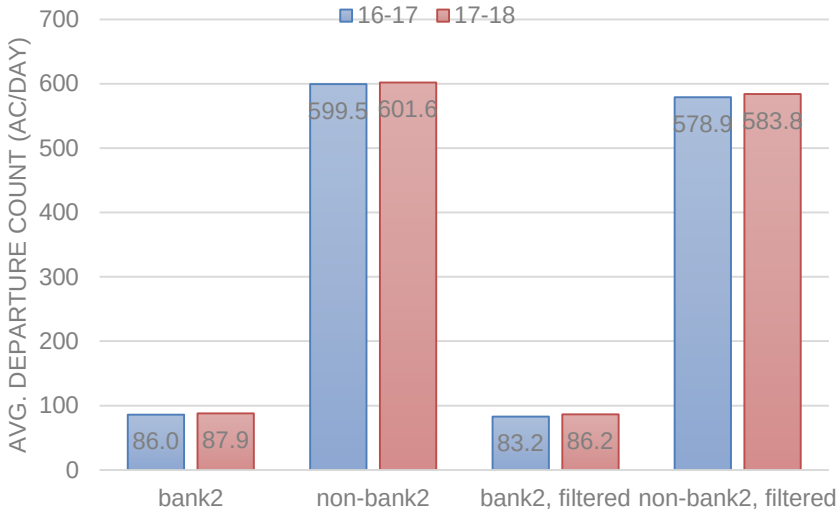
(min)	'16-17	'17-18
count	6,456	6,522
mean	12.8	13.6
stdev	7.9	7.9
median	11.0	12.0

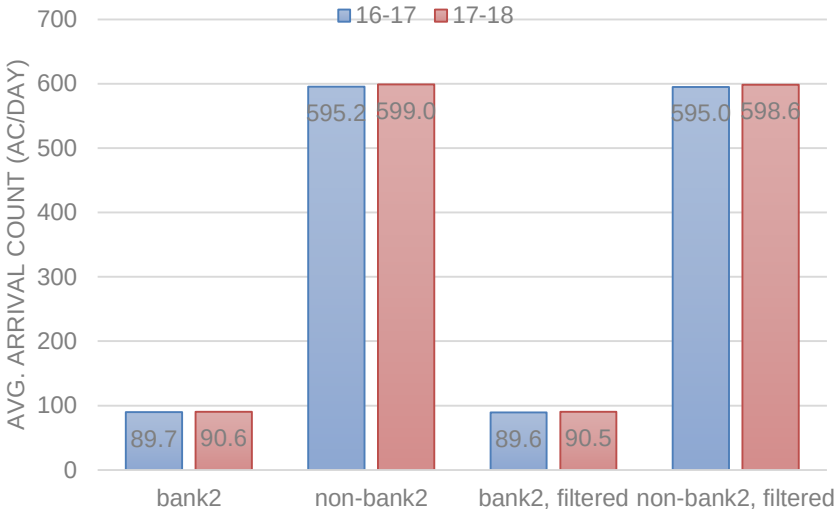


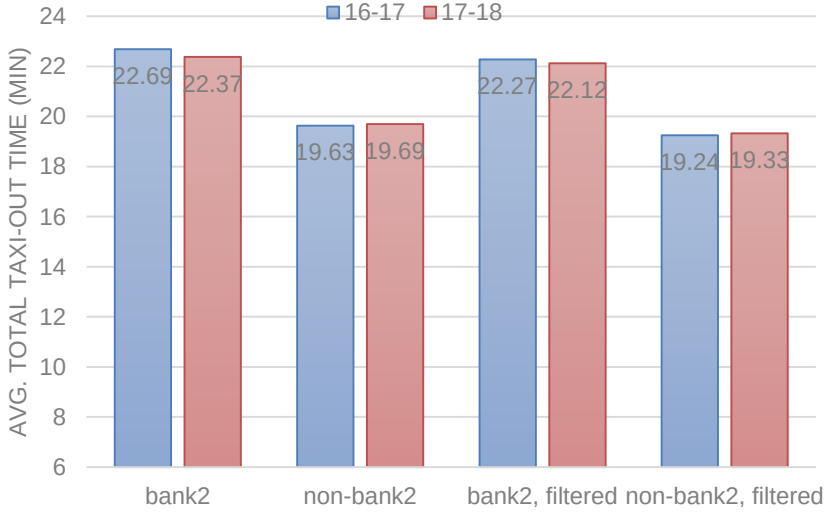
(min)	'16-17	'17-18
count	42,855	43,127
mean	11.0	11.5
stdev	6.2	6.7
median	10.0	10.0

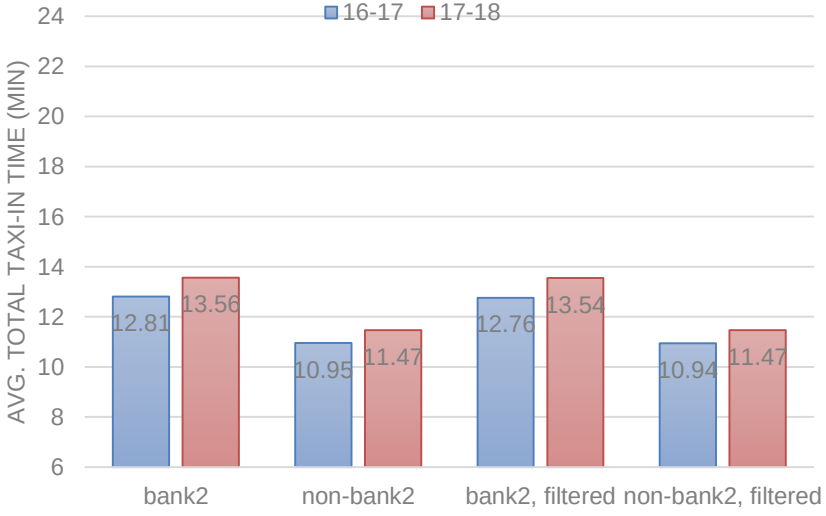
Average Traffic Demand and Taxi Times Based on OUT & ON Times

For departures, the average taxi-out time in bank 2 based on OUT times decreased with surface metering turned on, even though the traffic volume increased.







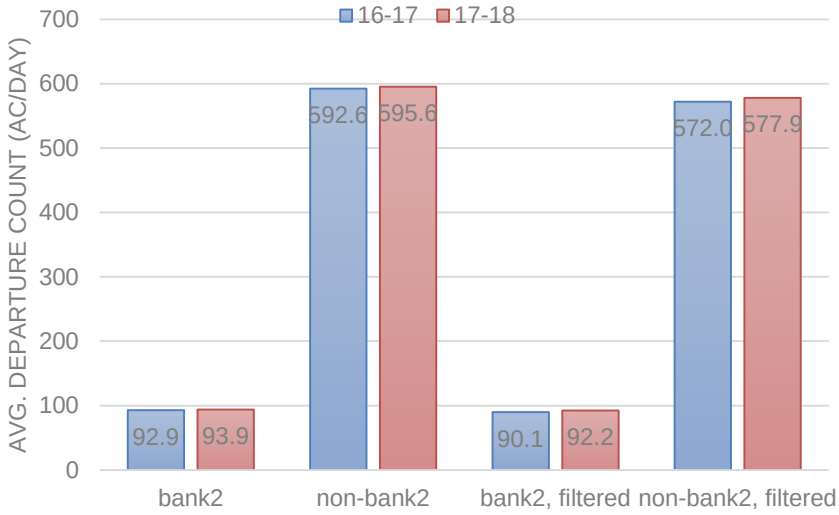


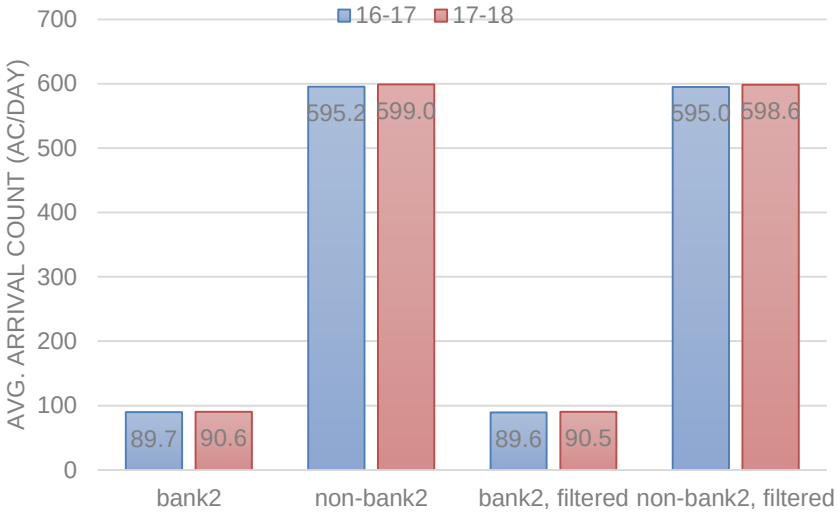
Departure filtering: No EDCT, 5min <= taxi time <= 60min

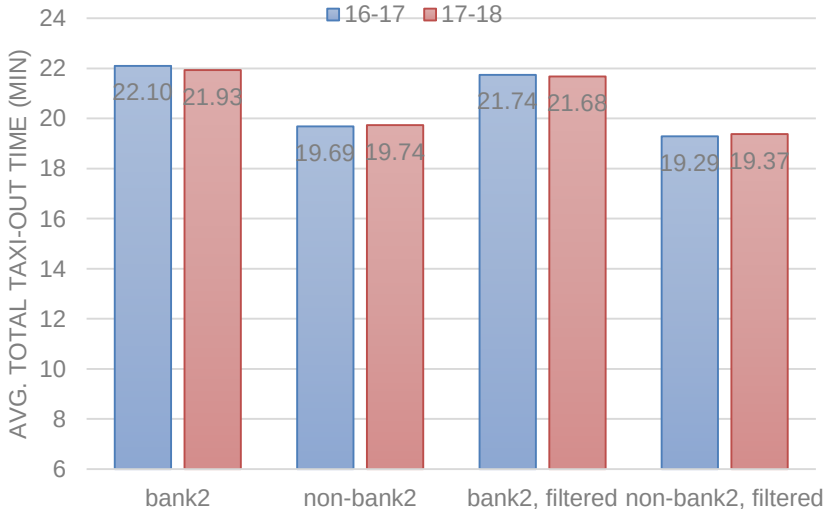
Arrival filtering: 2min <= taxi time <= 60min

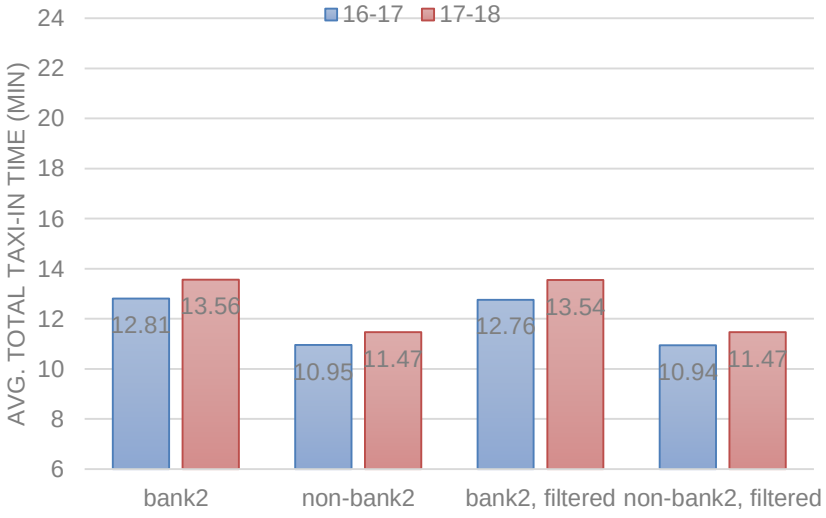
Average Traffic Demand and Taxi Times Based on OFF & ON Times

For departures, there is no significant impact on the average taxi-out time in bank 2 based on OFF times by the surface metering. The average taxi-in time increased mainly due to a traffic increase in ’17-18.









Departure filtering: No EDCT, 5min <= taxi time <= 60min

Arrival filtering: 2min <= taxi time <= 60min

Conclusions

- In this analysis, taxi-out/in times from ASPM data before and after surface metering were compared to see the effects of surface metering on airport efficiency.
- According to the overall comparisons, there was no significant difference on taxi-out times between pre- and post-metering datasets both within Bank 2 and beyond Bank 2. When the definition for Bank 2 changed from OUT times to OFF times, the results were same. These results mean the departure traffic volume did not change between two time periods, and the surface metering did not affect the total taxi-out times.
- For arrivals, the mean taxi-in times increased in ’17-18 regardless of peak times, but it seems that this increase came from the increased arrival traffic volume.
- Therefore, the surface metering from ATD-2 technologies at least did no harm in taxi-out times at CLT. Considering that the gate holdings from pushback advisories were included in the total taxi-out times, the actual taxi times might be reduced by gate hold times.
- Since this analysis was done only for the early days after the surface metering had turned on, more detailed data analyses should be conducted for overall evaluation in the future, including the effects on other airport performance metrics such as runway throughput, takeoff time predictability, queue size, and environmental benefits.