

# **RECAT I: Lessons Learned from MEM**

**Steven Lang**

**Clark Lunsford**

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# Acknowledgments

- **FAA, MEM Tower**
- **FedEx**
- **MITRE CAASD**
- **Volpe Center**



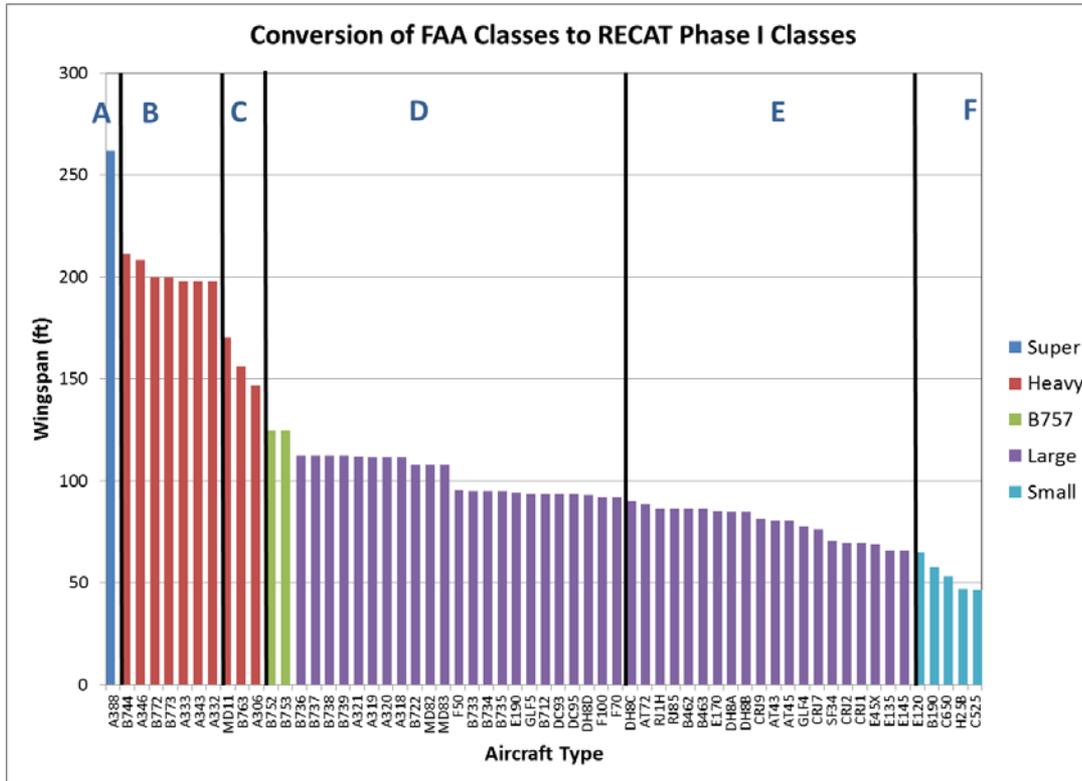
# Introduction/Background

- ➔ **The purpose of this summary is to identify the lessons learned at MEM to date, and how they can be applied elsewhere**
  
- ➔ **The benefits of RECAT I implementation at Memphis International Airport (MEM) were studied from a variety of perspectives and reported at WakeNet USA in March at Memphis**
  - MITRE CAASD conducted a general benefits analysis on RECAT I at MEM
    - ⦿ Call rates, aircraft spacing and queue times were the focus of this analysis, focusing on the FedEx pushes
  - Volpe conducted a general study of the effect of RECAT I on traffic
    - ⦿ What are the detectable operational changes at MEM before and after RECAT I
  - MEM Tower provided air traffic control user experience and the effect of RECAT I on their day-to-day operations
    - ⦿ Controllers embrace RECAT and are looking to further improve their operations
  - FedEx provided real user experience and the effect of RECAT I on their operations
    - ⦿ Benefits for the user-recipient may not be what was initially planned
  - Human Solutions Inc. provided feedback from human factors and controller workload/familiarity perspective





# RECAT I – Overview (1/2)



**Establishes six new wake categories based on an analysis of the sixty-one most common International Civil Aviation Organization (ICAO) aircraft types operating in the busiest airports of the EU and US**



# RECAT I – Overview (2/2)

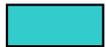
→ Implemented at Memphis International Airport (MEM) on November 1st, 2012

**RECAT Separation Matrix**

		Follower					
		A	B	C	D	E	F
Leader	A	MRS	5.0	6.0	7.0	7.0	8.0
	B	MRS	3.0	4.0	5.0	5.0	7.0
	C	MRS	MRS	MRS	3.5	3.5	6.0
	D	MRS	MRS	MRS	MRS	MRS	5.0
	E	MRS	MRS	MRS	MRS	MRS	4.0
	F	MRS	MRS	MRS	MRS	MRS	MRS



Separation was increased for some or all aircraft pairs



Separation was decreased for some or all aircraft pairs



Separation remained the same for some or all aircraft pairs

MRS

Minimum Radar Separation (3NM, or 2.5 NM when existing requirements are met)



# Multiple Ways to Measure Benefits

- **Four different entities studied benefits for RECAT implementation at MEM from different points of view**
  - MITRE and the Volpe Center provided an analytical study on changes observed before and after RECAT implementation
  - Air traffic control and FedEx provided the end-users prospective
- **The traditional definition of benefits related purely to capacity restraints was not necessarily the focus for all**
- **The end-users in the tower and the airlines provided a unique vantage point**
- **Efficiency**
  - Will provide intermediate measure of benefit until remaining constraints are removed and full RECAT capacity benefits can be observed
  - Is a more important metric for some user benefits because users choose how they change behavior as a result of the reduced separations



# MITRE Analysis



# MEM Operations and FedEx

- **MEM is the primary hub of operations for FedEx**
- **FedEx conducts two significant arrival and departure periods, or “pushes”, per weekday/non-holiday**
  - The larger of the two arrival pushes occurs between approximately 10pm and 1 am
  - The larger of the two departure pushes occurs between approximately 3am and 5am
  - These two pushes are the emphasis of this analysis
- **The FedEx fleet consists of predominately Heavy and B757 aircraft as classified under pre-RECAT separation standards**
  - ~85% of FedEx operations see separation reductions due to RECAT



# Observed Results Overview

## → **Departure taxi-out results**

- Departure average taxi-out time: 2 minutes reduction, with higher reductions for some runway configurations
- Departure queue time: 38% reduction

## → **Departure throughput and capacity results**

- Departure operations per hour: Average increase of 7 operations per hour during peak hours
- Departure called rates: The highest called rates are used more often; now used 30% of the time, increased from under 10% of the time

## → **Arrival capacity and throughput effected by arrival route limitations**

- Reduced flight time in arrival segment provided early indication of benefits
- With additional arrival routes, increased throughput is anticipated



# MITRE Summary/Conclusions

- **Arrival and departure called rates using higher values more often; lower values less often**
- **No significant change in arrival throughput yet until additional arrival routes are added, yet the time to fly during approach is reduced**
- **Departure throughput during pushes increase by 13% (3 departures per quarter-hour) post-RECAT**
- **Inter-departure separation times decreased by 16% under RECAT**
- **Post-RECAT taxi-out times and time spent in departure queue are lower post-RECAT**
- **Results are analyzed for FedEx late-night and early-morning only**
  - These results are preliminary as further investigation is still required for some metrics
  - Entire day to be analyzed for benefit to other carriers in September report



# Volpe Center Analysis



# Volpe Center: Traffic Analysis

- **A combination of Aviation System Performance Metrics (ASPM) Data and Airport Surface Detection Equipment, Model X (ASDE-X) Data was studied to determine changes in traffic patterns, particularly in aircraft pairing, spacing and runway occupancy times**
- **ASPM reports show an increase On-Time Gate arrivals as well as an increase in the number of arrivals during peak hours**



# Volpe Center Findings:

- **Runway occupancy time is similar overall since the implementation of RECAT I. But, there is a small noticeable reduction for the VMC case: 3.9s**
  - Standard Deviation is tighter post-RECAT I. What does this mean? Consistency and efficiency from the procedure, any variation at all is likely due to traffic mix
- **Pairing is similar pre- and post- RECAT I implementation. Most common pairs are Heavy(C)/Heavy(C) and Large(E)/Large(E). C/C provides capacity benefits**
- **Spacing measured in time has decreased post-RECAT I. For the most common pairs, spacing reduction is as follows:**
  - C/C: reduced by 35s (40s Peak hours)
  - E/E: reduced by 28s
  - Even F as follower was reduced overall except F-F (more consciously applying spacing on the controller's part?)
- **Taxiway usage on high-speed taxiway Y1 increased and also use of P by Class D and lower, which goes directly to the cargo area**



# MEM ATC Tower Perspective



# After Action Report

## → **Capacity Increase at MEM:**

- Departure – 22% increase
- Arrival – 15% increase

## → **Automation**

- STARS – Loss of NAS input for VFR FP
- EFSTS – Importance of Correct A/C type



# MEM Tower Summary

- **The facility is working on a list as it relates to upgrades of aircraft types, which are not in the current database for STARS/EFSTS. This list will continue to grow and at an appropriate time, be uploaded to the pertinent entities for update.**
- **Anticipated pilot reluctance to accept a departure/arrival clearance with less than traditional separation has rarely been encountered/reported. To date, there have been “zero” wake encounter reports received by the facility.**
- **Implementation went extremely smooth in hindsight. There was much skepticism, but once the new standards were instituted, it became apparent the workforce accepted them.**
- **Emotions ran high leading up to implementation, and just as quickly faded away. It has been virtually whisper quiet and my personal feeling is that you would encounter even greater resistance now if you were to try and take it away.**



# FedEx Perspective



# RECAT Benefits

- **RECAT has nearly eliminated the runway end departure queue**
- **Flights are no longer held at the ramp**
- **Taxi times have been reduced**
- **Time in terminal airspace reduced**
- **Sort delays have been mitigated**



# FedEx Summary

- **RECAT implementation in Memphis has been an unqualified success**
- **We have “implemented” now we must “exploit”**
- **Maximum benefit has been seen on departure**
- **“Capacity” is a false indicator of success**
- **Additional benefit remains to be achieved**
- **Other heavy centric airports should be fast tracked (IND, SFO, ANC, SDF, EWR)**



# Conclusions

- **There is no one single benefits metric that is meaningful to all organizations all of the time**
- **The goal of increasing capacity has additional consequences of improving day-to-day operations throughout the system**
- **Users quickly accepted RECAT and continue to identify ways to improve its use**
- **While industry focus is typically on arrival capacity, departure capacity gains were quicker to materialize and easier to measure**

