

# Simple Streaming Solutions for SWIM

Presented to: ATIEC 2016

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*Aviation Information World – Forecasting the Future*



# Goal

- Create sector analyzer using standardized aviation data (SFDPS Track Data) starting from *scratch*
- Use available open source and COTS tools as able
- Complete work in 8 weeks using one and half interns
- Create something both practical and pretty

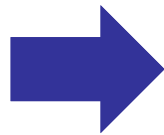


# Process

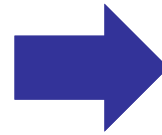
1. Parse streaming track elements (TH schema) from SFDPS
2. Extract temporospatial information and sector
3. Dynamically aggregate streaming filtered data
4. Visualize aggregated information



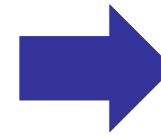
SFDPS feed  
FIXM & AIXM



Parsed Data



Aggregated Data



Data Visualized

# 1. Parse SFDPS Track Files

- **Connect to SFDPS**
  - Position (TH) messages transmitted every 15 seconds (or so) from SWIM SFDPS research domain
- **Process XML Chunks**
  - Each XML payload contains a varying number of track positions



## 2. Extract Temporospacial Information

Process streaming Track Data chunks on a *per position basis*

- For specific flight:

<uuidGufi>c2d9fe4f-f431-4c7e-9011-...</uuidGufi>

- At specific time:

<timeOfTrackData\_170a>20160-8T...</timeOfTrackData\_170a>

- Using only temporospacial tags, e.g.

<reportedAlt\_54a>260</reportedAlt\_54a>



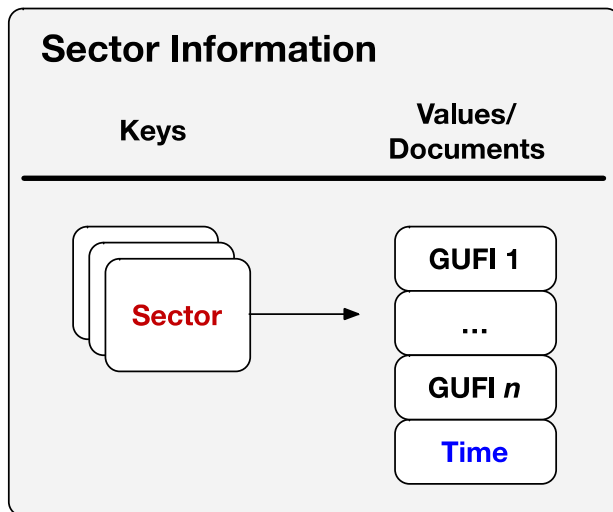
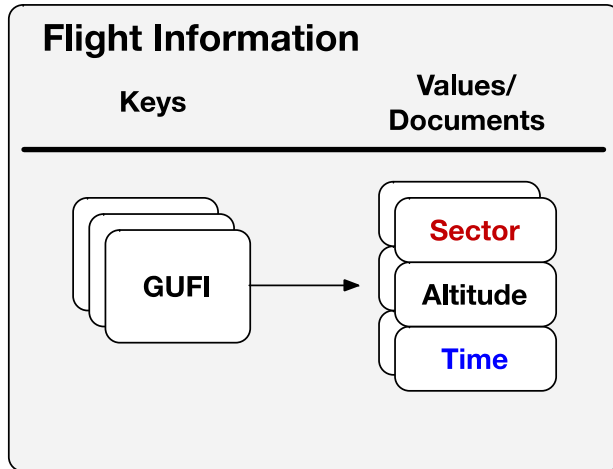


# 3. Aggregate Filtered Data

- **Chose mongoDB for streaming analysis**
  - Flexible (Key, Document) tuples
- **Use this structure to dynamically update linked values**
  - Flight characteristics
  - Sector characteristics



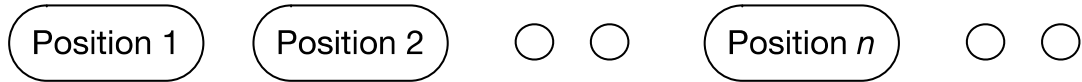
# 3.1 Aggregate Sector Data



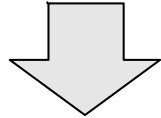
- 1. Positional Data is streamed into the Flight Collection**
  - GUFI is the primary key linked to a sector
- 2. Sectors Collection updated when a flight changes sector**
  - Sector is key to an array of GUFIs operating in that sector
- 3. When Sector Collection changes a *Sector Event* is created:**
  - Time
  - Sector ID
  - Sector Density (at this time)

# 3.2 Aggregate Sector Density

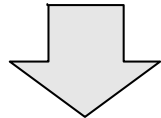
**Position Stream**



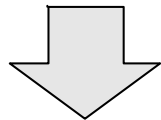
*for each position ...*



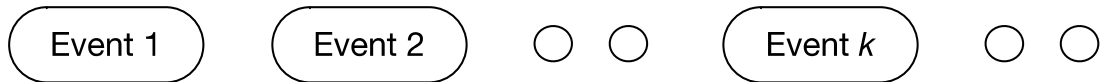
*flight changes sector*



*sector density changed*



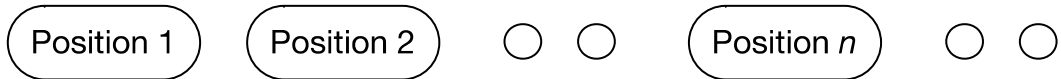
**Sector Event Stream**



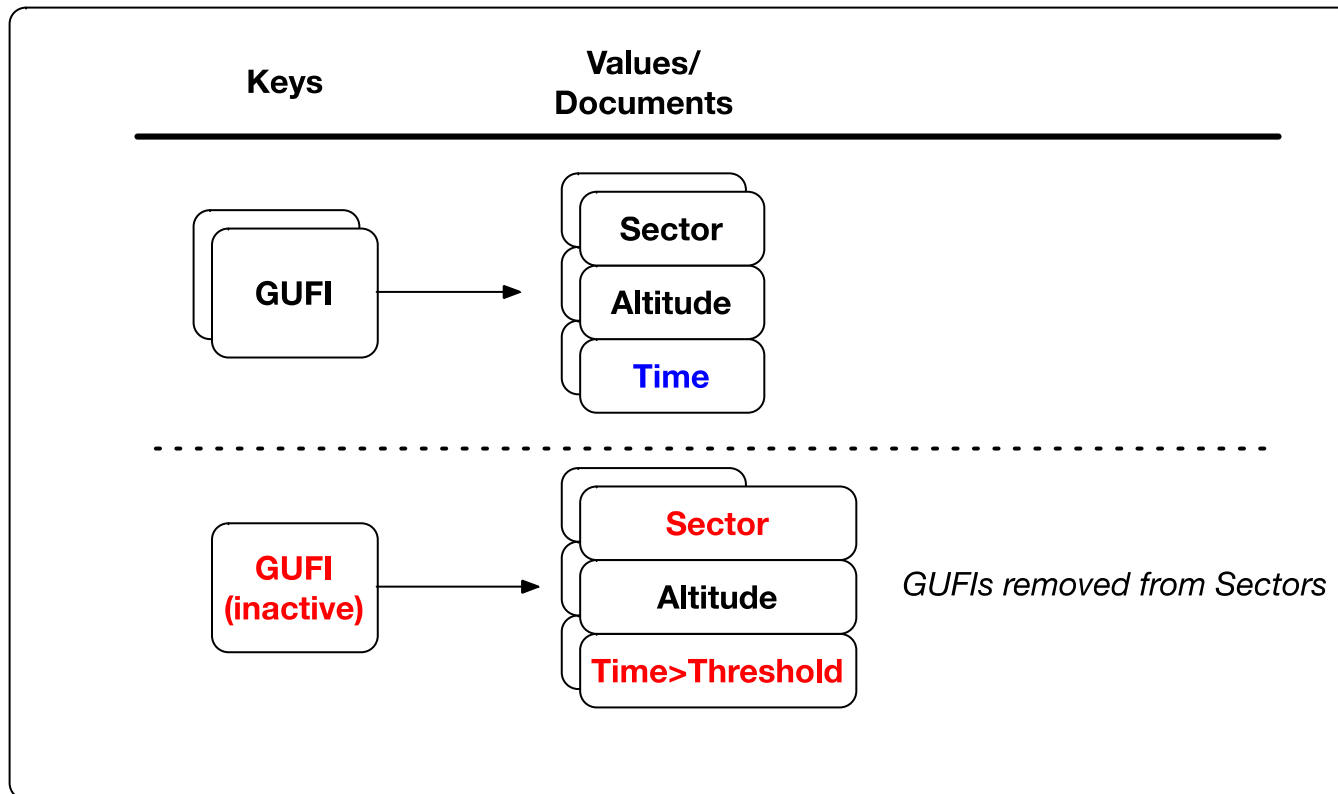


# 3.3 Garbage Collection

Position Stream



when position time passes threshold ...



# 4. Visualize Aggregated Information

- Chose Tableau for rapid display capability
- *Note:* however, streaming data will at this point be collected into static tables

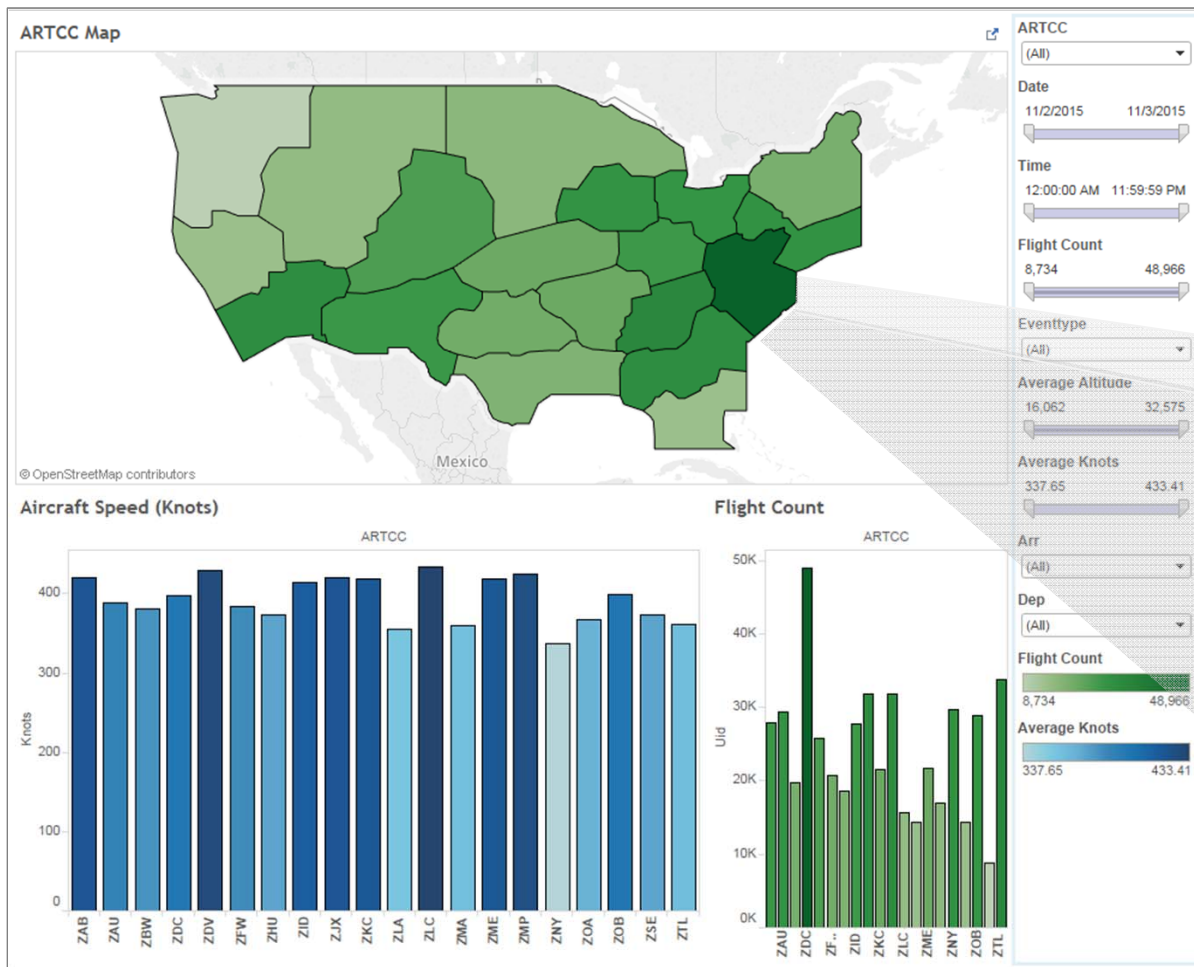


ARTCC performance metrics accessible with a few clicks

Performance can also be viewed at the sector level

Frequency of altitude change is also presented

Detailed dashboards can drill down to airport statistics



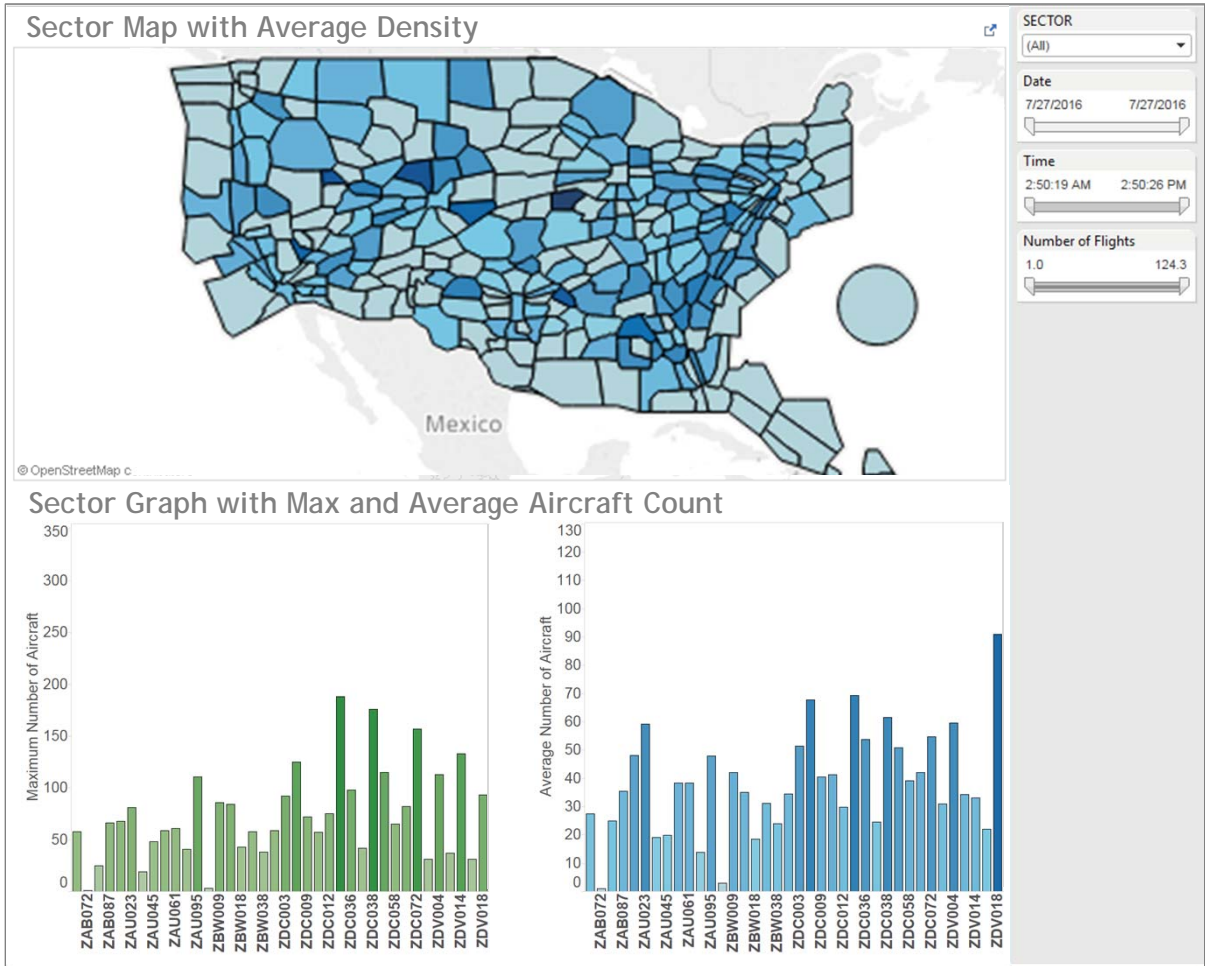
- ZDC with flight count for this period of time
- Mouse over to view various sector data

ARTCC performance metrics accessible with a few clicks

Performance can also be viewed at the sector level

Frequency of altitude change is also presented

Detailed dashboards can drill down to airport statistics



Data can be shown for over a larger or smaller period of time

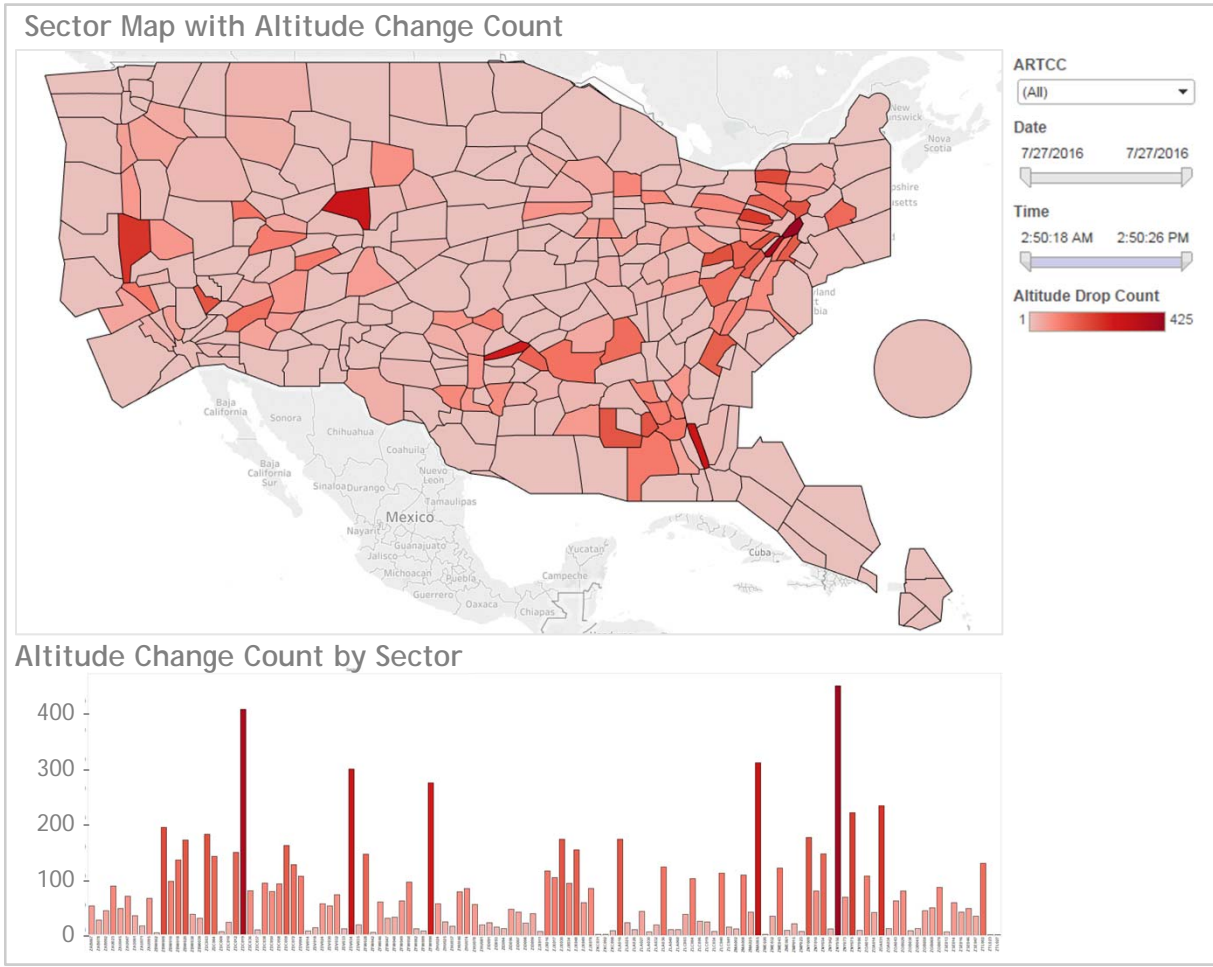


ARTCC performance metrics accessible with a few clicks

Performance can also be viewed at the sector level

Frequency of altitude change is also presented

Detailed dashboards can drill down to airport statistics



**With minimal processing and filters for what constitutes an altitude change event for a day or a few hours in the day**



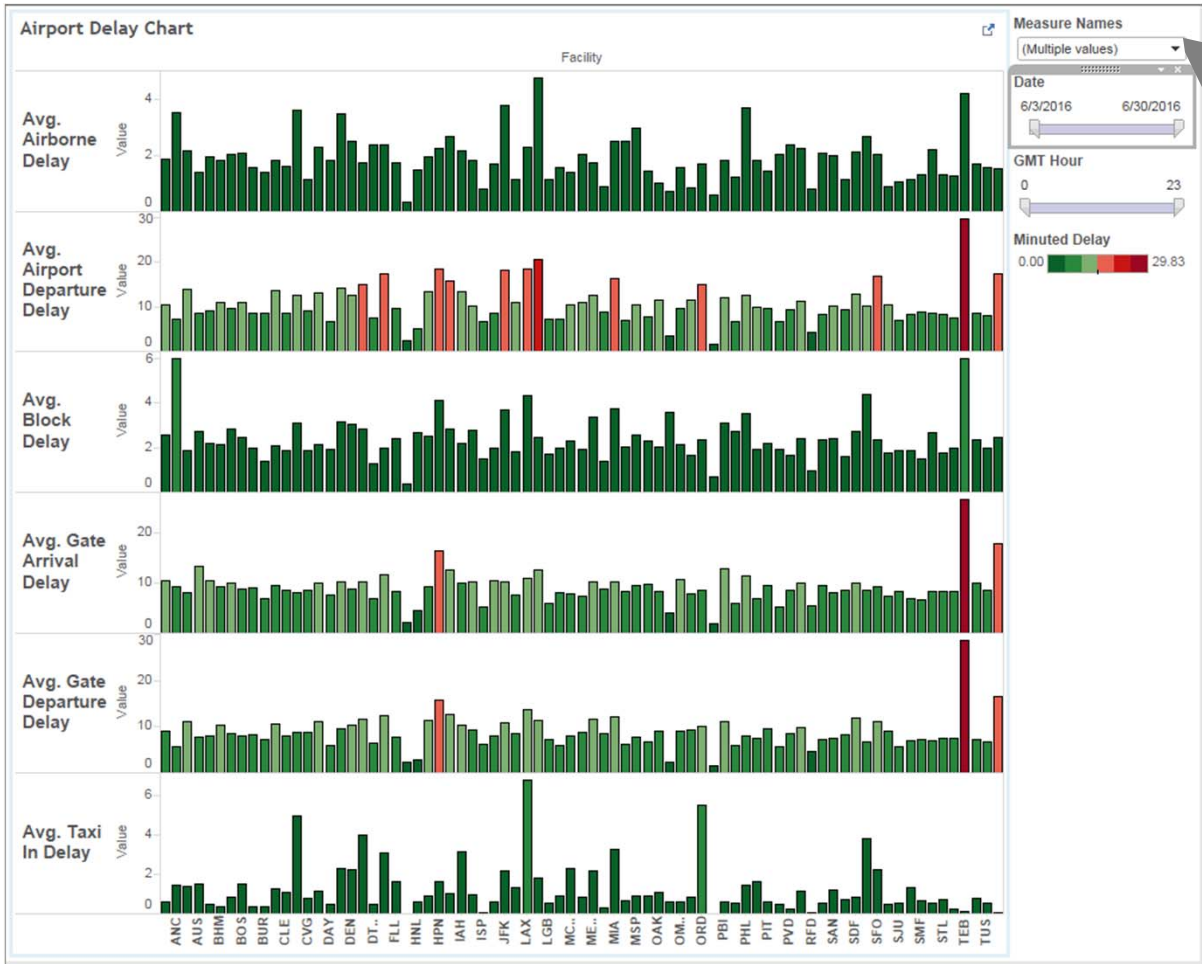


ARTCC performance metrics accessible with a few clicks

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Detailed dashboards can drill down to airport statistics



**Measure Names**  
 (Multiple values)  
 Enter search text

- (All)
- % On-TimeAirportDepartures
- % On-TimeGateArrivals
- % On-TimeGateDepartures
- ArrivalsFor MetricComputation
- Average Taxi Out Delay
- Average Taxi Out Time
- Avg. Airborne Delay
- Avg. Airport Departure Delay
- Avg. Block Delay
- Avg. Gate Arrival Delay
- Avg. Gate Departure Delay
- Avg. Taxi In Delay
- DeparturesFor MetricComputation
- Number of Records
- Scheduled Arrivals
- Scheduled Departures

# Credits (The Doers)

- **Vineet Velmurugan** is an intern for Noblis for the summer of 2015-2016, currently studying Aerospace Engineering at Virginia Tech and is due to graduate in the Spring of 2017. He has experience in modeling/simulation and data analysis across fields including aerodynamics, flight control, intelligent transportation systems and NAS.
- **Robert Raheb** is from Toms River, NJ and a rising senior at West Virginia University. I am working towards a bachelor's degree in Management Information Systems, with an area of emphasis in Supply Chain Management, and an interest in Data Analytics.
- **Vaishali Shah** is a Principal at Noblis, specializing in investment analysis, simulation and modeling, and stakeholder engagement serving multiple US DOT modal agencies. She received her Master's degree from the University of Texas at Austin in Transportation Systems.



# Questions

