REAL-TIME ALERTING OF FLIGHT STATUS FOR NON-AVIATION SUPPLIERS IN THE AIR TRANSPORTATION SYSTEM VALUE CHAIN

Real-time information to maximize profits

Lance Sherry (lsherry@gmu.edu)
Oleksandra Snisarevska
Michael Perry

Center for Air Transportation Systems Research
Organization

1. Background
2. Opportunity
3. Objectives
4. Design
5. Case Studies
   1. Airport Food Concession
   2. Airport Gate Leasing
   3. Passenger Concierge Service
6. Conclusions
Background

- Air Transportation System has a complex multi-level value chain

- First tier suppliers
  - Airlines
  - air traffic control

- 2\textsuperscript{nd} Tier suppliers
  - Catering
  - Baggage
  - Fuel
  - Aircraft Cleaning
  - ...

- 3\textsuperscript{rd} Tier suppliers
  - airport concessions
  - airport taxis
  - off-airport shuttles
  - airport maintenance
  - airport construction
  - ...

Center for Air Transportation Systems Research
Background

• ATS operational status (e.g. flight status) can be important to low tier operations
  • Adjust Schedules & Assignments:
    • catering & fuel supply
      • impacted when late arriving flights need to be serviced at the same time as previously scheduled on-time flights
  
  • Adjust Staffing and/or Inventories:
    • airport concessions
    • airport parking
    • rental cars
    • surface transportation
    • land-side and air-side construction and maintenance
Background

• **1\textsuperscript{st} tier suppliers**
  - Have access to data (e.g. flight status, airport status, ATM status, ...)

• **2\textsuperscript{nd} / 3\textsuperscript{rd} tier suppliers**
  - Can purchase, but need analytics engine to make operational decisions
  - **Data Suppliers**
    - FlightAware
    - FlightStats
    - FlightRadar24
    - http://www.ADSBexchange.com (Open Source)
    - https://opensky-network.org (Open Source)
    - ...
  - **Operational “Engines”**
    - Airport Labs
    - Springshot
    - AODB
Desk-top Solution (Airport Labs)
Mobile Solution (Airport Labs)
Mobile Solution (Springshot)

Avianca deploy Springshot
Airport Operational Data-base (AODB)

- AODB:
  - data relating to operational activity concerning flights and facilities
  - real-time data warehousing and retrieval of data from IT systems, and it provides the mechanism for the integration of systems throughout the site
    - Adhoc Schedule Messages (ASM)
    - Seasonal Schedule Messages (SSM)
    - International Air Transport Association (IATA) delay codes
    - aircraft movement messages. Typical flight data that the AODB stores includes:
      - Which aircraft arrived
      - When the aircraft arrived
      - Where the aircraft originated
    - Flight Information Display Systems (FIDS)
    - baggage reconcilement data for Baggage Information Display Systems (BIDS),
    - gate assignment data for Gate Information Displays (GIDS).
- Amadeus, Indra, SITA, ...

Center for Air Transportation Systems Research

www.airport-technology.com/
Opportunity

• Low Tier Suppliers:
  • High importance of the flight status to their business operations

But ...
• cost of purchasing access to a data feed may be prohibitive
• competencies required to develop and maintain hardware and software infrastructure may be beyond the capabilities of the organization
• Seasonal needs
• Temporary needs
  • during period of construction, or airline market-share wars
Objective

• Develop capability for operational alerting
  – Real-time
  – Data
    • Flights, Airport (Gates, Runways), ATM
    • NOTAMS
    • Weather
    • Passengers
    • Relevant News Events
  – Configure alerts
    • Compare to Scheduled or Historical data
  – Text or email
CONFIGURABLE REAL-TIME ALERTING SYSTEM (C-RTAS)
Case Studies

(1) Airport Food Concession
(2) Airport Gate Leasing
(3) Passenger Concierge Service
(1) Airport Food Concession

• Food concessions on gate concourse
• Staffed based on estimated customer demand
  – “normal” operations of the scheduled flights
• Staffing plan maximizes revenue for the “normal” days
• Irregular operations are in effect:
  – upto 3X more passengers/customers in the gate concourse area demanding service
• Without adjusting staffing:
  – significant number of passenger/customers go unserved
  – loss of revenue
(1) Airport Food Concession

• Airport
  – East-coast
  – Domestic flights-only
  – Terminal that services airline operators:
    • Legacy Network Carrier (LNC)
    • Shuttle
    • Low Cost Carriers (LCC #1, LCC#2 and LCC#3)
(1) Airport Food Concession

- Mean Daily Pax-Hours: 16,079 (1 Pax present for 1 hour)
- Standard deviation: 5,340 Pax-Hours
- Daily Pax-Hours hover around the mean most of the time, but significant periods of high Pax-Hours exist
- 39 days above $+2\sigma$

Total Pax-Hours Per Day

Days June 2015 to June 2017
(1) Airport Food Concession

- Excess Daily Pax-Hours (over Normal Ops)
- Mean Daily Pax-Hours = 630
- Standard deviation = 785
- Coefficient of variation = 1.2
(1) Airport Food Concession

- PDF Daily Excess Pax-Hours:
  - no left tail
  - “fat” right tail

![Density of Daily PAX in the Terminal, w/ mean and +1,2,3 sigma](image1)

![Density of Daily PAX.DIFF in the Terminal, w/ mean and +1,2,3 sigma](image2)
(1) Airport Food Concession

39 “meltdown” days
Spread equally between Summer (Convective weather) and Winter (Snow)

<table>
<thead>
<tr>
<th>DATE</th>
<th>PAX.DIFF</th>
<th>PAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/21/2015</td>
<td>3,111</td>
<td>25,243</td>
</tr>
<tr>
<td>7/30/2015</td>
<td>2,602</td>
<td>23,045</td>
</tr>
<tr>
<td>8/20/2015</td>
<td>2,375</td>
<td>22,333</td>
</tr>
<tr>
<td>12/23/2015</td>
<td>4,044</td>
<td>30,898</td>
</tr>
<tr>
<td>1/24/2016</td>
<td>2,466</td>
<td>21,454</td>
</tr>
<tr>
<td>2/5/2016</td>
<td>2,789</td>
<td>24,826</td>
</tr>
<tr>
<td>2/15/2016</td>
<td>2,334</td>
<td>23,050</td>
</tr>
<tr>
<td>2/16/2016</td>
<td>4,260</td>
<td>31,430</td>
</tr>
<tr>
<td>2/24/2016</td>
<td>2,314</td>
<td>22,998</td>
</tr>
<tr>
<td>2/25/2016</td>
<td>2,291</td>
<td>23,618</td>
</tr>
<tr>
<td>5/4/2016</td>
<td>3,604</td>
<td>39,785</td>
</tr>
<tr>
<td>5/6/2016</td>
<td>2,901</td>
<td>37,140</td>
</tr>
<tr>
<td>6/23/2016</td>
<td>2,752</td>
<td>24,100</td>
</tr>
<tr>
<td>7/1/2016</td>
<td>3,273</td>
<td>25,480</td>
</tr>
<tr>
<td>7/2/2016</td>
<td>2,444</td>
<td>19,555</td>
</tr>
<tr>
<td>7/25/2016</td>
<td>2,458</td>
<td>22,386</td>
</tr>
<tr>
<td>8/8/2016</td>
<td>4,828</td>
<td>31,999</td>
</tr>
<tr>
<td>8/11/2016</td>
<td>3,482</td>
<td>26,280</td>
</tr>
<tr>
<td>8/12/2016</td>
<td>3,366</td>
<td>26,083</td>
</tr>
<tr>
<td>9/28/2016</td>
<td>3,151</td>
<td>36,620</td>
</tr>
<tr>
<td>10/28/2016</td>
<td>3,151</td>
<td>36,620</td>
</tr>
<tr>
<td>11/22/2016</td>
<td>2,381</td>
<td>21,178</td>
</tr>
<tr>
<td>12/17/2016</td>
<td>5,539</td>
<td>33,795</td>
</tr>
<tr>
<td>12/18/2016</td>
<td>2,231</td>
<td>21,168</td>
</tr>
<tr>
<td>1/7/2017</td>
<td>2,584</td>
<td>17,953</td>
</tr>
<tr>
<td>2/9/2017</td>
<td>3,593</td>
<td>26,613</td>
</tr>
<tr>
<td>2/12/2017</td>
<td>2,271</td>
<td>19,369</td>
</tr>
<tr>
<td>2/13/2017</td>
<td>2,959</td>
<td>23,704</td>
</tr>
<tr>
<td>3/2/2017</td>
<td>2,826</td>
<td>24,138</td>
</tr>
<tr>
<td>3/14/2017</td>
<td>3,297</td>
<td>26,383</td>
</tr>
<tr>
<td>3/22/2017</td>
<td>2,363</td>
<td>22,433</td>
</tr>
<tr>
<td>3/28/2017</td>
<td>2,498</td>
<td>22,878</td>
</tr>
<tr>
<td>4/6/2017</td>
<td>3,628</td>
<td>27,806</td>
</tr>
<tr>
<td>4/7/2017</td>
<td>3,351</td>
<td>26,828</td>
</tr>
<tr>
<td>4/9/2017</td>
<td>2,416</td>
<td>21,610</td>
</tr>
<tr>
<td>5/1/2017</td>
<td>2,774</td>
<td>24,373</td>
</tr>
<tr>
<td>5/5/2017</td>
<td>5,048</td>
<td>33,075</td>
</tr>
<tr>
<td>5/25/2017</td>
<td>3,097</td>
<td>25,369</td>
</tr>
<tr>
<td>6/19/2017</td>
<td>3,394</td>
<td>25,819</td>
</tr>
</tbody>
</table>
(1) Airport Food Concession

- Pax-Hours by Time of Day
- Irregular Ops exacerbates the peaks
(1) Airport Food Concession

• Anticipating Irregular Ops (i.e. +2 sigma event):
  – hold over a shift an additional 2 hours
  – Additional Profit $46K - $141K per year
    • 70% Confidence Interval

  – Note: adjusting the staffing plan to match the flight schedule (not the traditional staffing plan), profit increase by $518K per year
(2) Airport Gate Leasing

- Real-time alerting for a hypothetical scenario
  - major west coast airport
  - international airport
  - situated on small parcel of land adjacent a body of water
  - limited taxiway and ramp areas
  - Congestion on surface has impact on large number of flights
  - *Airport management take active role in airport ops*
(2) Airport Gate Leasing

• Fall of 20XX, flights arriving at airport experience long taxi-in times (e.g. greater than 45 minutes) across multiple carriers
• Airport management becomes aware
  – social media
  – traditional media
  – Post-operations analysis (from ATC provided data)
• Airport management need to investigate and quickly
  – surface surveillance track data could not sufficient to identify the true causes of the delays
  – Need to be at the gates on ramp to see
  – Not systemic, so waste of time to sit and wait
    • Need real-time alerting
SUBJECT: Taxi-in Time Alert UAL 1294

- Flight UAL 1294
- From LAX to SFO
- Scheduled Arrival 12/2/17 10:22:00AM Local Time
- Actual Arrival 12/2/17 11:05:13AM Local Time
- Current Taxi Time 45 minutes and counting
- Scheduled Gate 73 (Terminal 3)
- Weather at SFO 999nm, 100OVC
- Codeshares: NZ 9282
(2) Airport Gate Leasing

- Avg 496 domestic arrivals per day
  - 14,906 arrivals in month X

- 5 **Legacy Network Carriers** (LNC) operated domestic flights
  - 69% of the arriving flights
  - LNC2 + LNC2-Regional
    - 54% of the total arriving flights (i.e. hub operation).
    - Avg 271 arrivals per day

- 6 **Low Cost Carriers** (LCC)
  - 31% of the arriving flights
## (2) Airport Gate Leasing

### One month Taxi-In Statistics

<table>
<thead>
<tr>
<th>Carrier</th>
<th>Total</th>
<th>Avg Arrs per Day</th>
<th>Cancelled</th>
<th>Div</th>
<th>Count</th>
<th>%</th>
<th>Count</th>
<th>%</th>
<th>Count</th>
<th>%</th>
<th>Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNC1</td>
<td>1096</td>
<td>36.5</td>
<td>0</td>
<td>3</td>
<td>874</td>
<td>79.74</td>
<td>194</td>
<td>17.70</td>
<td>25</td>
<td>2.28</td>
<td>1</td>
</tr>
<tr>
<td>LCC1</td>
<td>60</td>
<td>2.0</td>
<td>0</td>
<td>0</td>
<td>52</td>
<td>86.67</td>
<td>8</td>
<td>13.33</td>
<td>0</td>
<td>0.00</td>
<td>1</td>
</tr>
<tr>
<td>LCC2</td>
<td>557</td>
<td>18.6</td>
<td>9</td>
<td>2</td>
<td>475</td>
<td>85.28</td>
<td>70</td>
<td>12.57</td>
<td>1</td>
<td>0.18</td>
<td>Intl</td>
</tr>
<tr>
<td>LCC3</td>
<td>451</td>
<td>15.0</td>
<td>1</td>
<td>6</td>
<td>408</td>
<td>90.47</td>
<td>30</td>
<td>6.65</td>
<td>6</td>
<td>1.33</td>
<td>1</td>
</tr>
<tr>
<td>LNC2-Reg</td>
<td>3001</td>
<td>100.0</td>
<td>38</td>
<td>13</td>
<td>2618</td>
<td>87.24</td>
<td>313</td>
<td>10.43</td>
<td>19</td>
<td>0.63</td>
<td>1,3</td>
</tr>
<tr>
<td>LNC2</td>
<td>5150</td>
<td>171.7</td>
<td>45</td>
<td>17</td>
<td>4298</td>
<td>83.46</td>
<td>710</td>
<td>13.79</td>
<td>80</td>
<td>1.55</td>
<td>1,3, Intl</td>
</tr>
<tr>
<td>LCC4</td>
<td>1476</td>
<td>49.2</td>
<td>56</td>
<td>5</td>
<td>1285</td>
<td>87.06</td>
<td>129</td>
<td>8.74</td>
<td>1</td>
<td>0.07</td>
<td>1</td>
</tr>
<tr>
<td>LCC5</td>
<td>1861</td>
<td>62.0</td>
<td>16</td>
<td>3</td>
<td>1657</td>
<td>89.04</td>
<td>139</td>
<td>7.47</td>
<td>46</td>
<td>2.47</td>
<td>2</td>
</tr>
<tr>
<td>LCC6</td>
<td>182</td>
<td>6.1</td>
<td>3</td>
<td>0</td>
<td>139</td>
<td>76.37</td>
<td>34</td>
<td>18.68</td>
<td>6</td>
<td>3.30</td>
<td>1</td>
</tr>
<tr>
<td>LNC3</td>
<td>1072</td>
<td>35.7</td>
<td>18</td>
<td>7</td>
<td>968</td>
<td>90.30</td>
<td>75</td>
<td>7.00</td>
<td>4</td>
<td>0.37</td>
<td>2</td>
</tr>
<tr>
<td>ALL</td>
<td>14906</td>
<td>480.8</td>
<td>186</td>
<td>56</td>
<td>12774</td>
<td>85.70</td>
<td>1702</td>
<td>11.42</td>
<td>188</td>
<td>1.26</td>
<td></td>
</tr>
</tbody>
</table>

**Count of flights with Excess taxi-In Times**

- < 15 mins
- 16 - 45 mins
- > 45 mins

Center for Air Transportation Systems Research
# Flights with Taxi-In Time > 45 minutes per Day

<table>
<thead>
<tr>
<th>Carrier</th>
<th>Sept  1 or More Arrivals per Day</th>
<th>Sept  3 or More Arrivals per Day</th>
<th>Sept  5 or More Arrivals per Day</th>
<th>Oct  1 or More Arrivals per Day</th>
<th>Oct  3 or More Arrivals per Day</th>
<th>Oct  5 or More Arrivals per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNC1</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>11</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>LCC1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LCC2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LCC3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LNC2-Regional</td>
<td>13</td>
<td>1</td>
<td>0</td>
<td>17</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>LNC2</td>
<td>22</td>
<td>10</td>
<td>8</td>
<td>20</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>LCC4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LCC5</td>
<td>7</td>
<td>4</td>
<td>4</td>
<td>9</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>LCC6</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LNC3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>All</td>
<td>29</td>
<td>20</td>
<td>13</td>
<td>28</td>
<td>16</td>
<td>11</td>
</tr>
</tbody>
</table>

Center for Air Transportation Systems Research
(2) Airport Gate Leasing

• **Over or Tight Gate Scheduling**
  – LNC2/LNC-Regional
    • operating a hub at the airport
    • engaged in a "marketshare" war with a newly merged "low cost carrier" (LCC5) competitor
    • LNC increased frequency of flights
      – Tightened the turn-around schedule to have enough gates
    • did not lease additional gates from the airport
  – By observing the operations in-person
    • better able to understand the issues
    • made additional gates available to all airlines
(2) Airport Gate Leasing

• Propagation of NAS-wide Delays
  • Newly merged LCC5 also increased frequency of flights
    – Transcontinental operator
    – Gate schedule has more slack
    – Impacted by NAS-wide (east-coast) delays
      • late arriving flights creates temporary demand for gates in excess of gate capacity
        – bank of late flights (e.g. from east coast) coincides with on-time flights (e.g. from west-coast only)
    – Alleviated by making “spare” gates available on an as-needed basis
(3) Passenger Concierge Service

• Deregulated airline marketplace has provided consumer benefits:
  – reduced airfares
  – options for amenities
  – quality of service (?)

• Deregulated airline marketplace has NOT provided consumer benefits:
  – reliability of the transportation service with regard to on-time gate arrivals

  • 2016, U.S. domestic operations
    – 81% on-time performance/27% of the flights operated not on time
      » 28% were attributed to “carrier delays.”
      » disruptions that cannot be attributed to Extraordinary Circumstances (EoCs)
        • extreme weather
        • national airspace system congestion
        • late arriving aircraft
        • security.
(3) Passenger Concierge Service

- European Commission EC-261/ Passenger Bill of Rights (PBR) law, known as EC261
  - protect consumers
  - incentivize airlines to address disruptions under their operational jurisdiction
- Requires airlines to compensate passengers:
  - when flights that are not under EoC:
    - are delayed by more than 180 minutes
    - cancelled without advance notice
(3) Passenger Concierge Service

• Passengers can submit claims directly to airlines
• Passengers can submit claims through 3rd party
  – Charge fee for service (e.g. 25% of claim)
  – Process paper-work
    • Identify non Extra-Ordinary Circumstances
  – Provide legal services
(3) Passenger Concierge Service

- EC 261 is not well known
- Passengers get frustrated processing claims
  - Cannot identify EOC
- Need a way to target customers that are eligible
- Con-Ops
  - Part-time employee
  - Meet passengers eligible for EC-261 at baggage claim
  - Sign passengers up in realtime
(3) Passenger Concierge Service

- Flight departing late CDG by threshold cannot make up enough time to arrive JFK with delay less than 180 minutes
- Checks for Extra-Ordinary Circumstances
(3) Passenger Concierge Service

Email sent to representative:

Flight VS 23
LHR Scheduled/Actual Departure Time 12/11/2017 3:20:00 PM / 12/11/2017 8:09:00 PM (UTC time).
LAX Scheduled/Estimated Arrival Time 12/12/2017 2:35:00 AM / 12/12/2017 7:24:00 AM (UTC time).
Arrival 289 minutes late.
No Extra-ordinary circumstances. Flight has an estimated XXX passengers on-board.
Arriving Gate Xn.
Baggage Claim: #X
Codel shares:
DL 4404
9W 5822
SQ 2523
VS 23
Conclusions

• Proto-type proved low-cost capability
• Pilot Projects proving financial benefits

• Isherry@gmu.edu