NASA Airline Operations Center Research

Richard Mogford, Ph.D.
Airline Operations Center

• An airline operations center (AOC) is an airline’s global headquarters for aircraft dispatchers and other personnel
• Dispatchers have the authority to originate and terminate flights
• They generate flight plans and monitor flights throughout their routes
• AOCs also provide other functions, such as crew scheduling and maintenance management
AOC Research Areas

• AOC automation
  – Applied IBM’s Watson “cognitive computing” to airline operations
  – Objective was to improve access to documents (e.g., FAA regulations, airline procedures, etc.) and Internet resources

• Winter weather
  – Developing a decision support tool to support operations during winter storms

• Improving partnerships with airline industry

• Creating AOC laboratory to support research
  – In Ames Human Systems Integration Division
AOC Automation

• Contracted with IBM for a feasibility study to apply Watson to support the AOC
• Delivered report in December 2015
• Report outlines how Watson could be applied to the AOC to improve access to and interpretation of the large amounts of data needed by dispatchers and other airline personnel
Cognitive Computing

- Cognitive computing systems are trained using artificial intelligence and machine learning algorithms to sense, predict, infer and, in some ways, think.
- They can process natural language and unstructured data and learn by experience, much in the same way humans do.
- They help human experts make better decisions by penetrating the complexity of “Big Data”.
- Cognitive computing systems improve over time as they build knowledge and learn a domain.
- By using visual analytics and data visualization techniques, cognitive computers display data in a visually compelling way that enlightens humans and helps them make decisions.
- IBM has already developed and demonstrated cognitive computing in industry and medicine.

The above is quoted from: http://www.research.ibm.com/cognitive-computing
Watson for AOC

- IBM report (December 2015) recommended two phases of Watson AOC deployment
  - Static data (large documents, etc.)
  - Gather data from Internet and air/ground messaging
- Requested NASA funding to cover Phase 1
- Other NASA centers are exploring Watson applications
- No further Watson work for the AOC anticipated for now
- IBM now owns WSI, which has the Fusion AOC system
  - May incorporate Watson
Winter Weather

- Developing the “Flight Awareness Collaboration Tool” (FACT)
- Concentrates information about winter weather events on one display
- Includes predictive tools
- Supports collaboration between AOC, air traffic control, airport authority, and de-icing operation
- User interface developed and application coding is underway
- Space Act Agreement with Virgin America
  - Backup AOC at Ames
- User group at Detroit airport
FACT Information

- Weather status and forecasts
- FAA Winter Weather Dashboard
- Prediction/reporting of runway closures for snow/ice treatment
- Runway braking action
- Visual display of surface traffic movement at airport
- Airport runway configuration (capacity)
- De-icing durations, type of fluid needed, throughput times
- FAA actions (e.g., ground stops, miles-in-trail, etc.)
FACT Information

- Notices to Airmen
- FAA Operational Information System
- Aviation Digital Data Service icing information
- Taxi times (from gate push back to departure, including de-icing)
- Runway visual range
- Tracking of arrival flights in en route airspace to determine if hold or divert will be needed
FACT Design

<table>
<thead>
<tr>
<th>Profiles Bar</th>
<th>Quick View Tabs</th>
<th>Quick View Tabs</th>
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<tbody>
<tr>
<td></td>
<td><strong>Primary Map View</strong></td>
<td><strong>Surface Map View</strong></td>
</tr>
<tr>
<td></td>
<td>displays current US map</td>
<td>displays current airport surface map</td>
</tr>
<tr>
<td></td>
<td>ZOOM/PAN CONTROLS/COLLAPSIBLE MENU</td>
<td>ZOOM/PAN CONTROLS/COLLAPSIBLE MENU</td>
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<td>Quick View Tabs</td>
<td>Quick View Tabs</td>
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<tr>
<td></td>
<td><strong>Information View</strong></td>
<td><strong>Communication View</strong></td>
</tr>
<tr>
<td></td>
<td>formatted data for current airport</td>
<td>communication with other groups and issue tracking</td>
</tr>
<tr>
<td></td>
<td>ZOOM/PAN CONTROLS/COLLAPSIBLE MENU</td>
<td>ZOOM/PAN CONTROLS/COLLAPSIBLE MENU</td>
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FACT User Interface Design

(From FACT User Interface Specification document)
Primary Map View
Surface Map View
Information View

### ATCSCC ADVISORIES FOR WEDNESDAY, 06-10-2015

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Quicklinks: FAA OIS, Aviation Weather Center, FAA NOTAMs, WWACM

Name: FLA_TO_NYMETROS
Constrained area: ZJX/ZMA
Information View

FAA Winter Weather Dashboard

Quicklinks
Communication View

LGA: Too many aircraft in de-icing area.

JFK: UAL 3740 stall in de-icing area. Expect a 20 min delay.

Comments:
- dpekni: Not sure how to deal with this one, any suggestions?
  Here's the procedure, attachment.
- eleong: That's an old document I believe.
- rmogford: I'll update and send a new document to the team.
Communication View

Hello there...
Richard Mogford 8:56:14 AM

It seems like we're getting a lot of warnings about ice and heavy freezing rain.
Richard Mogford 8:56:14 AM

The group is tracking and shows an hour or more...
Richard Mogford 8:56:14 AM

Thanks for the update, have a good one.
Before I forget, there's another front coming in, so stay tuned for additional info.
Richard Mogford 8:56:14 AM

Type your message here & press Enter or the send icon to submit...
FACT Details

- FACT is a web-based application
- Receives JAVA messages from the FAA System Wide Information Management data repository
- Surface movement data are from ASDE-X
- Data are acquired from web pages and tailored for the Information View
- Predictive tools will be built into FACT
- First one competed is Metron’s Winter Weather Airport Capacity Model (WWACM)
  - Predicts changes in airport departure rates from weather forecasts

ASDE-X = Airport Surface Detection Equipment, Model X
WWACM for BOS for February 16, 2013
The 77 airports included in WWACM
WWACM in FACT
FACT Prototype
Primary Map
Surface Map
<table>
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<tr>
<td>092</td>
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Communication

TWO MANY AIRCRAFT IN THE DE-ICING AREA

CREATED DATE: 2016-06-14T00:40:02.000Z
MODIFIED DATE: 2016-08-01T16:44:15.297Z
AUTHOR: admin
SHARED WITH:

F.A.C.T

NOTES:

NOTES ARE EMPTY FOR THIS ITEM

COMMENTS:

00:40:27Z  admin (Me)  test

00:40:34Z  admin (Me)  test

21:32:56Z  admin (Me)  asdfasdfasdf

ADD A COMMENT
FACT Progress

• Web-based prototype will be completed in mid-2017
• Plan to demonstrate FACT to airlines and airports to seek feedback
• Will make modifications and improvements
• Exploring other prediction tools (e.g., diversions manager, planning snow removal)
• Developing AOC simulator at NASA Ames to evaluate FACT
NASA/Industry Collaboration

• Held Airline Operations Workshop (AOW) in August 2016 at NASA Ames
  – Three days
  – Around 200 attendees
  – Focused on NASA, FAA, and private sector innovations to support the airlines (AOC and flight deck)
  – Breakout groups identified gaps where research is needed
  – Successful in raising awareness of AOC issues

• AOW research recommendations
  – Improve AOC simulation
  – Study dispatcher workload, situation awareness, errors
  – Display/system integration
  – Managing/accessing large information databases from multiple sources
  – Preferred routes issues
AOW Follow-up

• Virtual meeting
  – Planning a virtual meeting for November 2016 to follow up on recommendations
  – Will form working groups to grow research ideas

• Raising awareness about AOC
  – Briefed NASA AOC topics to DoD Human Systems Community of Interest meeting
  – FAA Infoshare
  – Presented at Airline Dispatchers Federation Summit
  – Meeting with US Marine Corps
  – Awarded initial funding from Transformative Aeronautics Concepts Program, Convergent Aeronautics Solutions Project for “Digital Dispatcher” proposal

DASC = Digital Avionics Systems Conference
NASA Ames Airline Operations Research Group (AORG) Laboratory

Working with Ames laboratories to create an AOC simulation capability

Room 289 in N262
Questions?

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650-604-1922