METEOROLOGICAL IMPACTS ON UNIVERSAL E-LINES OPERATIONS

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ABSTRACT

Middle Tennessee State University’s Department of Aerospace operates a simulated airline flight dispatch center for Universal E Lines, a virtual airline. This facility is named the NASA FOCUS (Flight Operations Center Unified Simulation) Lab. The airline serves sixteen communities in seven states in southeastern United States and is based in Nashville, TN with hubs in Nashville and Jacksonville, FL. The flight operations center is a one of a kind academic facility and in is modeled after similar facilities used by commercial airlines.

Weather is a leading cause for delays and cancellations in commercial aviation. Although meteorological factors cannot be controlled, their impact on airline operations must be carefully considered and their potential effects mitigated. In the NASA FOCUS Lab real-time current weather data from the NWS is used enhancing the realism and fidelity of airline operations in this simulation. The Universal E Lines meteorologist is responsible for accessing and interpreting weather data for the safe and efficient operation of the airline and for providing timely information and recommendations to flight crews and center personnel about conditions that would require alterations in flights.

The use of real-time weather necessitates the use of a metric to standardize variability in weather. A recently developed four part/seven point weather rubric attempts to grade weather severity, its impact on airline operations and the effectiveness of the airline’s meteorologist. In the preliminary phase of this study, the weather rubric is being tested and refined. FOCUS Lab staff and aerospace faculty complete this tool at the end of each session and a numeric score is determined and assigned to the training session.

The aviation student, as an airline employee and meteorologist, is given orientation and familiarization training sessions by FOCUS Lab’s staff members covering the technical and procedural aspects of their position prior to their scheduled shifts in the flight operations center. The meteorologist has online access to weather information through the US Government National Oceanic and Atmospheric Administration National Weather Service aviation weather website, <aviationweather.gov>. This site provides on the ground airport and in the air enroute meteorological information for the southeastern states of Alabama, Florida, Georgia, Kentucky, North Carolina, South Carolina and Tennessee. The meteorologist is also responsible for monitoring NOTAMs or FAA Notices to Airmen and advising the airline about airport hazards and runway closures.

The flight operations center is staffed by ten students functioning as airline employees at a variety of stations essential for the safe and efficient operations of the airline. The environment during airline and lab operations is very dynamic and interactive as the airline launches and recovers twenty-five aircraft on eighty flights in a three-hour session.

The safe and orderly operation of any airline requires the orchestration of many competent, well-trained and experienced aviation professionals. The NASA FOCUS Lab is an excellent source for such training prior to aerospace graduates entering the workforce.
The captain or pilot in command is ultimately responsible for the safe operations of an aircraft and flight. This responsibility is shared and is done in conjunction with other members of the flight crew and airline dispatch operations.

The airline dispatcher when releasing an aircraft for flight must consider many factors to include crew scheduling, aircraft preparation and readiness, weight and balance, maintenance status and meteorological conditions. These later conditions are provided by the airline’s meteorologist. They are responsible for amassing, assessing and interpreting weather conditions, advising dispatch and flight crews in keeping with airline and Federal Aviation Administration policies and regulations.

Weather or meteorological conditions are a significant factor in airline operations. The same factors that make rapid transit possible also may jeopardize safe aircraft operations. For this reason, it is essential to have an appropriate understanding of the meteorological conditions an aircraft might experience in flight. Everyday hazards that one might experience in ground transportation with minimal risks such as reduced visibility, cloud cover, precipitation, freezing and winds may seriously effect an aircraft’s safe operation. For this reason, it is essential for the flight crew to have an understanding and interpretation of departure, enroute and arrival or destination weather and flight conditions provided by the airline meteorologist. These conditions can rapidly change and deteriorate during the course of a flight. In addition to conducting a safe flight, meteorological conditions may also seriously impact flight schedules with delayed departures and late arrivals, the need for alternate arrival airports, de-icing and inflight atmospheric conditions such as precipitation, convection and turbulence that require an alteration to flight plan.

Atmospheric or meteorological conditions may be limited to local weather with reduced visibility and ceilings and precipitation and to regional or transcontinental systems with the same impact multiplied by many factors. When combined, these factors greatly affect the on time performance of an airline.

While Universal E Lines operations is a computer based simulation, when conducting flight operations the airline uses real time weather of current atmospheric conditions. This information and data is provided by the NOAA, National Oceanic and Atmospheric Administration, NWA, National Weather Service website, <aviationweather.gov>. As these are real life, real time conditions, they vary daily for each laboratory session. Some sessions, these conditions have minimal or no impact on airline operations; on other sessions, they may have a great impact. In order to access an impact factor, a grading rubric has been devised to help develop and assign a co-efficient factor to grade or scale these meteorological factors. In addition to on time departures and arrivals, financial gains and losses, the utilization of a weather rubric provide a means for performance correlations due to meteorological conditions.

Flight operations for Universal E Lines are conducted in the MTSU Department of Aerospace NASA FOCUS Lab twice weekly with senior level aerospace students from a variety of aerospace disciplines in a capstone class. In the course of the three hour sessions, eighty
flights more than 3000 passengers are conducted with the Universal E Line’s virtual fleet of thirty, CRJ-200, Canadian Regional Jet model 200 aircraft. These flights are conducted as a regional airline from sixteen airports with two hubs in the southeastern United States. Seven states are served, to include Kentucky, Alabama, North Carolina, South Carolina, Georgia and Florida. Universal E Lines is based in Nashville, Tennessee where its dispatch center is located, with hubs in Nashville and Jacksonville, Florida. Cities served include in Alabama: Birmingham (KBHM); in Florida: Jacksonville (KJAX), Miami (KMIA), Orlando (KMCO), Pensacola (KPNS), Tallahassee (KTLH), and Tampa (KTPA); in Georgia: Atlanta (KATL) and Savannah (KSAV); in Kentucky: Louisville (KSDF); in North Carolina: Raleigh Durham (KRDJ) and Charlotte (KCLT); in South Carolina: Charleston (KCAE); in Tennessee: Memphis (KMEM), Nashville (KBNA) and Knoxville (KTYS). At each airport, approved primary and secondary runway conditions for arrivals have been selected with standard weather minimums of $\frac{1}{2}$ mile visibility and 200 foot ceilings for IMC/instrument meteorological conditions.

The airline meteorologist is a student trained in one to two semesters of meteorology. As an airline employee, the meteorologist is given orientation and familiarization training sessions by FOCUS Lab staff members covering the technical and procedural aspects of their position prior to their scheduled shifts in the flight operations center. A senior level Aerospace undergraduate student, trained in meteorology and knowledgeable in Universal E Lines airline policies and procedures and Federal Aviation Administration regulations for airline operations, staffs the weather position in the FOCUS Lab. They are responsible for accessing the weather conditions likely to be experienced on departure, enroute and upon arrival for each of the eighty flights conducted, and their release is required for each aircraft operation. They must also provide timely meteorological information and warnings to flight crews flying the airline’s fleet. They must consider meteorological conditions that would require de-icing, compliance with crosswind and tailwind allowances, visibility and ceilings for departure. When necessary, alternate arrival airport must be advised when weather minimums violate the 1-2-3 rule (arrivals within $\pm$ 1 hour of planned arrival time, 2000 foot ceiling and 3 statute mile visibility) for arrivals. This requires the addition of one hour’s fuel, 3000 pounds of Jet A fuel, to the aircraft with the removal of baggage, freight and passengers as needed not to exceed aircraft weight limitations, which affect the airlines costs and profitability. The meteorologist must advise the flight operations center and flight crews when such conditions exist. In addition, enroute conditions must be assessed and considered to include winds aloft, precipitation, turbulence, convection and icing. Flight plans must deviate due to enroute convection: thunderstorms, hail, tornadoes; severe headwinds aloft may lengthen flight times and turbulence aloft may require the alteration of the flight level or altitude at which a flight is conducted. Once again, additional fuel maybe required and baggage, freight and passengers reduced for the addition of fuel, affecting on time arrival performance and airline profitability. Arrivals and departures may be delayed or cancelled due to severe local, regional or national weather systems that jeopardize safe operations or do not meet airline or government standards. If airports are closed due to local weather conditions, flight departures may be delayed or alternate airports may need to be selected for arrivals. Likewise, these meteorological conditions greatly impact the airline’s operations.
WEATHER DATA

Weather data is primarily provided and accessed from <aviationweather.gov> website which provides real-time weather for the United States. This website provides current satellite and radar imagery as well as local weather information. The local weather comes from METARS, or meteorological aviation report, hourly report of surface meteorological conditions and, TAF, or terminal aerodrome forecast for anticipated weather within five statute mile radius of an airport for up to thirty hours in advance. Routine information provided and reviewed includes warnings or advice to crews for inflight icing, turbulence, convection, precipitation and reduced visibility in SIGMETS, or Significant Meteorological Information, freezing levels, winds and temperature aloft. Prognostic charts provide current and anticipated weather up to 48 hours in advance.

WEATHER RUBRIC

The use of real time weather data which varies on an hourly basis necessitates the use of a metric to standardize and calibrate variability in weather. Having identified this need, a four part/seven point rating scale or rubric has been devised to numerically quantitate or grade the weather severity and its impact and influence on airline operations. The effectiveness of the airline meteorologist is also graded. In the preliminary phase of this study, the weather rubric is being tested and refined. The grading rubric is completed at the end of each flight operations simulation by multiple NASA FOCUS Lab staff and aerospace faculty adept at interpreting meteorological data and familiar with current weather conditions. The four parts include:

- Overall Impact on Universal E Lines Operations; has been rated at 2.7;
- Weather Severity; has been rated at 2.6;
- Meteorological flight conditions; have been rated at 2.9 and
- Airline Meteorologist Effectiveness; has been rated at 4.5.

A one to seven scale is employed, one being low impact or effectiveness to seven being the greatest impact or effectiveness. At the time of this presentation, 11 Laboratory Sessions have been conducted, with seven airline meteorologists, evaluated by 7 qualified aerospace staff members with one consistent evaluator in all sessions. There is consistency in ratings amongst all raters, generally to within + or – one (x +/- 1).

Correlations have yet to be reached with this newly implemented tool. In the Spring 2012 semester, twenty lab sessions will be conducted, and with their completion, sufficient data may exist to correlate weather severity with airline operations for time delays and financial losses. Due to other ongoing studies and determinants, we have not been able to directly correlate meteorological factors to on time performance and financial data at this time.

CONCLUSIONS

Many meteorological factors are considered for the safe, efficient and timely operations of the airline. The NASA FOCUS Lab Universal E Lines weather rubric is a means to standardized or equilibrate weather or meteorological factors and assign a numerical co-efficient grading of meteorological factors and their impact when accessing daily airline operations.
# NASA FOCUS LAB WEATHER RUBRIC 2012

<table>
<thead>
<tr>
<th>TEAM</th>
<th>SESSION</th>
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<tbody>
<tr>
<td>AIRLINE METEOROLOGIST</td>
<td>STAFF METEOROLOGIST</td>
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## Overall Impact on Universal Lines Operations

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<tr>
<th>1</th>
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<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>1=NO IMPACT: NO FLIGHTS RESCHEDULED, DELAYED, REROUTED OR CANCELLED DUE TO WEATHER</td>
<td>2=MINIMAL IMPACT: MINOR INCONVENIENCES, A FEW FLIGHTS HAVE WEATHER ISSUES</td>
<td>3=LOW IMPACT: LESS THAN 25% OF FLIGHTS ARE DIRECTLY OR INDIRECTLY AFFECTED BY WEATHER</td>
<td>4=AVERAGE IMPACT: ABOUT 1 IN 3 FLIGHTS HAS SOME WEATHER RELATED ISSUE</td>
<td>5=MODERATE IMPACT: AT LEAST HALF OF THE FLIGHTS HAVE SOME WEATHER ISSUE</td>
<td>6=HIGH IMPACT: THE MAJORITY OF FLIGHTS HAVE WEATHER DELAYS OR ISSUES</td>
<td>7=SEVERE IMPACT: THE AIRLINE IS GROUNDED</td>
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## Weather Severity

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<tbody>
<tr>
<td>1=NO WEATHER, EITHER LOCALLY OR REGIONALLY</td>
<td>2=ISOLATED PERIODIC WEATHER LOCALLY WITH NO IMPACT</td>
<td>3=SIGNIFICANT LOCAL WEATHER WHICH CAUSES MINOR DELAYS</td>
<td>4=SIGNIFICANT PROLONGED LOCAL WEATHER</td>
<td>5=SIGNIFICANT PROLONGED REGIONAL WEATHER</td>
<td>6=SEVERE REGIONAL WEATHER IMPACTING MAJORITY OF STATES AND AIRPORTS</td>
<td>7=SEVERE REGIONAL AND NATIONAL WEATHER SYSTEMS WITH MAJOR IMPACT</td>
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## Meteorological Flight Conditions

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<tbody>
<tr>
<td>1=GENERALLY VISUALL METEOROLOGICAL CONDITIONS</td>
<td>2=MINIMQL ICING, TURBULENCE, CONVECTION, PRECIPITATION</td>
<td>3=MODERATE ICING, TURBULENCE, CONVECTION, PRECIPITATION</td>
<td>4=ALTERNATE FLIGHT PLANS FILED DUE TO LOW VISIBILITY AND CEILINGS</td>
<td>5=ALTERNATE AIRPORTS USED DUE TO LOW VISIBILITY AND CEILINGS</td>
<td>6=SEVERE ICING, TURBULENCE, CONVECTION, PRECIPITATION</td>
<td>7=TORNADOES, HURRICANES</td>
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## Airline Meteorologist

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<tr>
<td>1=CLUELESS</td>
<td>2=NO PREPARATION</td>
<td>3=KIND OF CAUGHT ON, ALWAYS BEHIND</td>
<td>4=AVERAGE, TYPICAL PERFORMANCE, GOOD COMPREHENSION AND COMMUNICATIONS</td>
<td>5=BETTER THAN MOST, AHEAD OF TIME, VERY GOOD SKILLS</td>
<td></td>
<td></td>
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</table>
6=DID A GREAT JOB, GREAT COMPREHENSION, ANTICIPATION AND SKILLS
7=WOW, SHOULD BE WORKING FOR THE WEATHER CHANNEL, EXCEPTIONAL