Quantifying Aviation Weather Forecast Benefits – an FAA Investment Analysis Perspective

Presented to: Friends/Partners in Aviation Weather Forum

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NAS Acquisition Programs

Flight Efficiency/Delay Savings Claims during Adverse Weather

Surface, Terminal

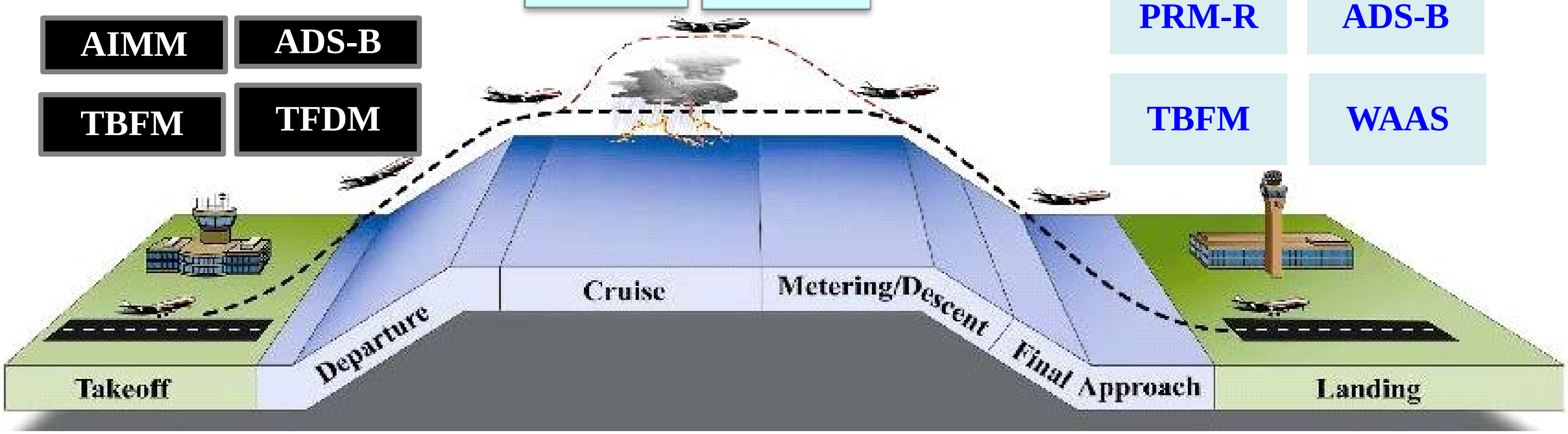
- ASDE-X
- CATMT
- CSS-WX
- DATA COMM
- ELVO
- NWP
- AIMM
- ADS-B
- TBFM
- TFDM

En Route

- AIMM
- CATMT
- CSS-WX
- DATA COMM
- ERAM
- ERAM Future
- NWP
- NVS
- ADS-B
- TBFM

Terminal, Surface

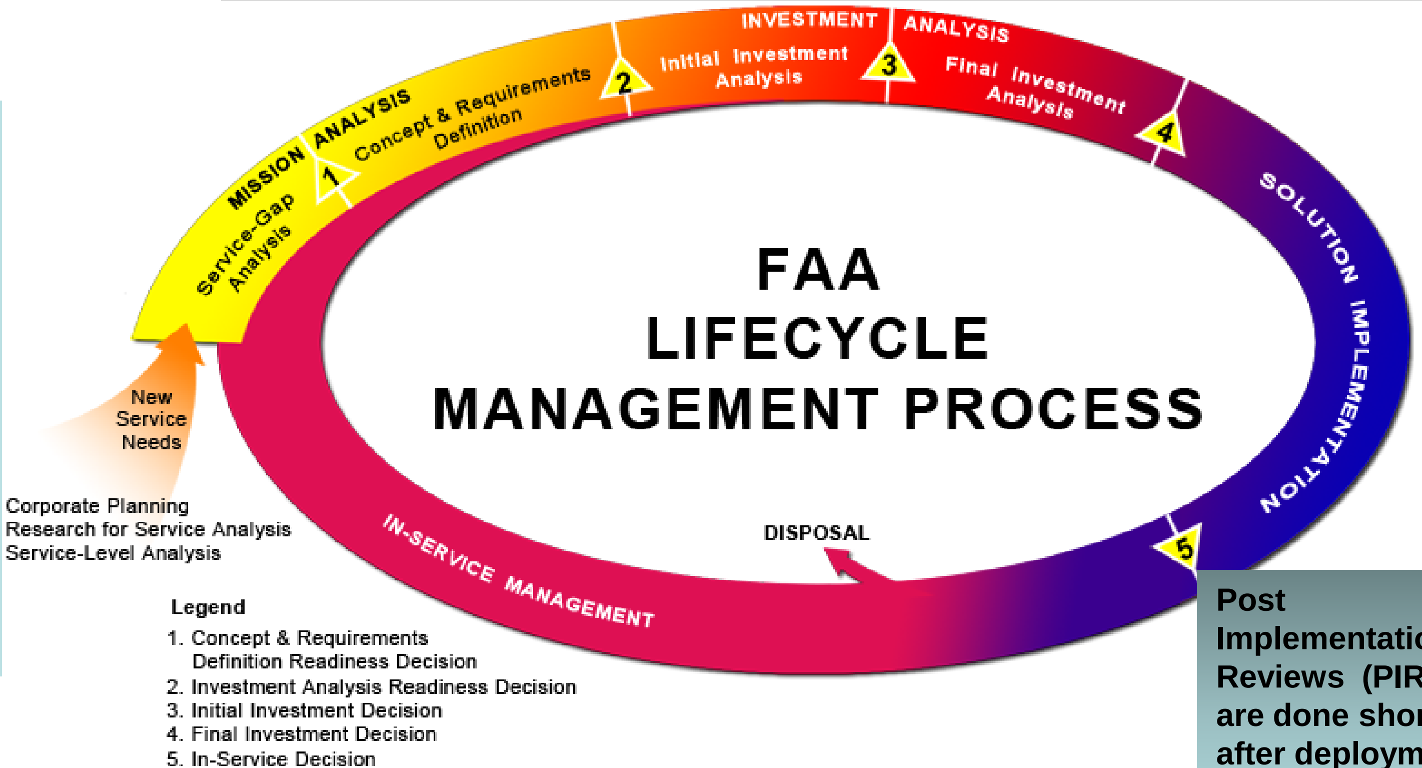
- CATMT
- CSS-WX
- DATA COMM
- ERAM
- ERAM Future
- ITWS
- NWP
- Future Facilities
- PRM-R
- ADS-B
- TBFM
- WAAS



FAA's Acquisition Management Process

The FAA's Investment Planning and Analysis Office works closely with the program offices to ensure a defensible business case moves forward

METRICS are identified, developed, and transformed into *benefits*. All Facilities and Equipment (F&E) acquisition programs go through the investment analysis process.



Post Implementation Reviews (PIRs) are done shortly after deployment -- includes benefits measurements

FAA Weather Programs
Forecast Related

Program	Forecast Mechanism	Key Benefit Categories	Primary Metrics
Weather Radar Processor (WARP)	Updated mosaics from NEXRADS	1) Navigating through holes, 2) deviating further upstream, 3) avoiding storm cells behind a front in en-route airspace	**Delay savings** ***en-route***
Integrated Terminal Weather System (ITWS)	0-1 hour forecast for terminal areas	1) Arrival transition areas, 2) departure transition areas and 3) runways (better capacity utilization)	**Delay savings** ***airborne and ground***
NextGEN Weather Processor (NWP) ***Replaces CIWS prototype***	ARTCC based tool 0-2 hour forecast, echo tops, includes winter weather products	1) Keeping routes open, 2) pro-active rerouting	**Delay savings** ***airborne and ground*** **Safety** **Cost Avoidance**
NextGEN Weather Processor (NWP) ***Replaces CoSPA prototype***	Longer term forecast – 2 to 8 hours	1) AFP execution management, 2) enhanced playbook reroute planning and execution and 3) enhanced reroute planning	
Terminal Doppler Weather Radar (TDWR)	Aviation weather products: precipitation, microburst, gust fronts, and related hazardous wind shear thru better detection	Increased safety in the terminal area	**Safety**

FAA Program – CATMT-WP2

Capabilities that use Forecast Weather to make Air Traffic Decisions

Program	Forecast Mechanism	Key Benefit Categories	Primary Metrics
CATMT- WP2 Route Availability Planning Tool (RAPT)	Integration of CIWS echo top and precipitation forecasts into display	Better departure route management, Improved route impact planning	**Delay savings (ground)**
CATMT-WP2 Traffic Flow Management System (TFMS)	Integration of CIWS products on Traffic Situational Displays (TSDs)	Keeping routes open longer, pro-active rerouting	**Delay savings (airborne and ground)**
CATMT- WP2 Collaborative Airspace Constraint Resolution (CACR)	Proposes effective, efficient, and integrated resolutions to airspace congestion problems. Actions are based on 0-2 hour forecast weather	More efficient routes through better utilization of reduced airspace capacity	**Delay savings (airborne and ground)**

Illustration of Assessing Operational Performance - ITWS

Input

Purpose was to justify ITWS at 12 additional sites through data-driven analysis

Used CLT as existing site to establish the basis for capturing the benefits of ITWS

Meteorology assessment of 1-minute movies of weather and traffic into CLT

GOAL was to determine times when weather "should have" impacted runways and Arrival Transition Areas (ATAs) and Departure Transition Areas (DTAs) in TRACON

Identified a sufficient sample of candidate pre/post day events at CLT since ITWS was operational at time of analysis.

Meteorologists captured start/stop times and storm impact for each day

Output

Time Period	Mean Flight Time during Impacted Time (100-40nmi)	Overall Mean Flight Time Good Weather Days(100-40nmi)	Arrival Savings
Pre-ITWS	18.19	12.79	
Post- ITWS	15.73	12.02	
Difference	2.47 min	.77 min	1.7 min

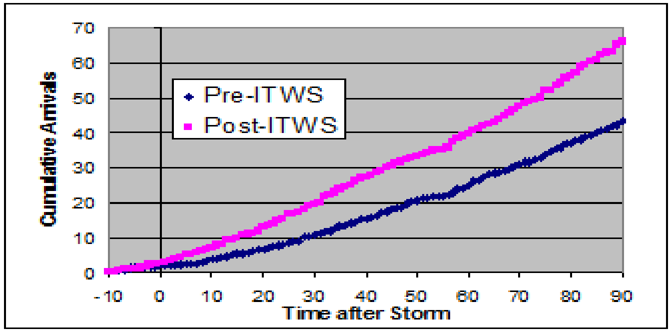
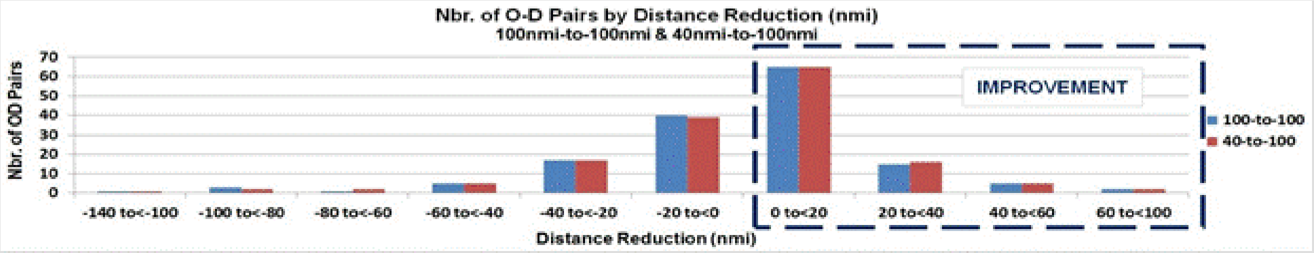


Illustration of Assessing Operational Performance - CIWS

Meteorology assessment of NCWD data to capture sufficient set of sample days with convective weather

Pre- Period						Post- Period					
Date	Time (Z)	ZKC	ZMP	Intensity 1-4	Echo Top Opp.	Date	Time (Z)	ZKC	ZMP	Intensity 1-4	Echo Top Opp.
7/8/2004	1100-1400		X	2	YES	6/21/2007	1800-2300		X	2 to 3	Yes (early)
7/8/2004	1400-1800	X		2 to 3	Yes	6/28/2007	1000-1600	X		2	Yes
7/11/2004	0200-0400		X	3	Maybe	6/29/2007	1000-1600	X		2	Yes
7/11/2004	1000-1700		X	3 to 4	Maybe (late)	6/30/2007	1300-1700	X		2 to 3	Yes
7/14/2004	1000-1300		X	2 to 3	Maybe (late)	7/3/2007	1100-1600		X	2 to 3	Yes
7/16/2004	1000-1500	X		3	Maybe	7/8/2007	1100-1400		X	3 to 4	Maybe
7/21/2004	1000-1300		X	3	Yes	7/18/2007	1800-2300		X	2 to 3	Yes
7/23/2004	1000-1800	X		2	Yes	7/22/2007	1100-2100		X	2 to 3	Maybe

OBJECTIVES – **1)** to capture ***data driven change*** in airborne metric from pre-implementation to post-implementation for identifying change in airborne performance at ZMP and ZKC with CIWS, **2)** compare with discrete-event simulation modeling outputs

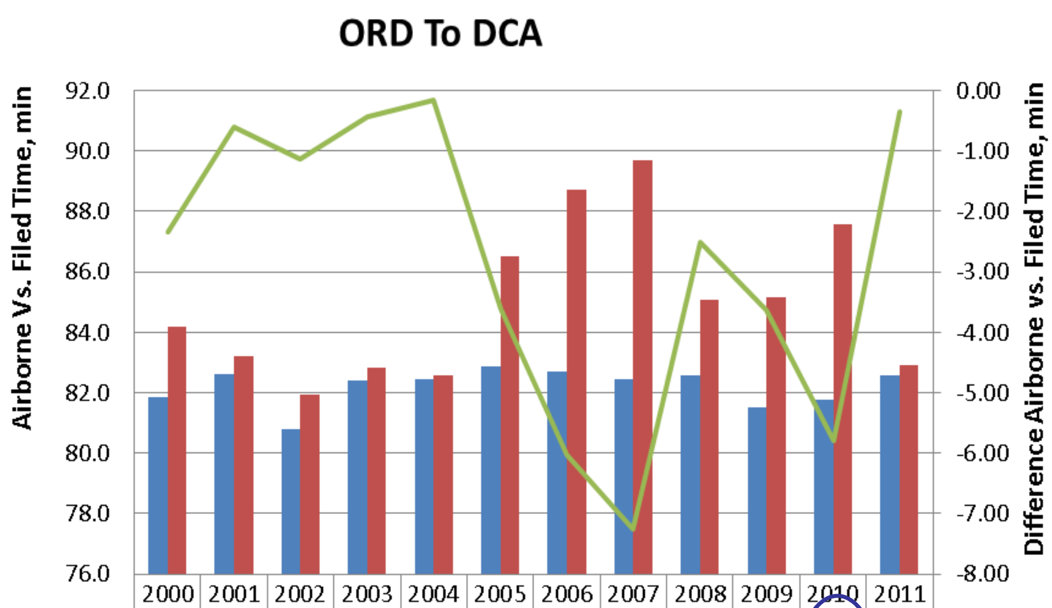


Year	Airborne Delay (min)	Flts. Eval
Pre-CIWS (2004)	1.84	1529
Post-CIWS (2007)	1.06	1441
Difference	-0.78	

Illustration of Our Challenge

Airborne Time From ORD to DCA

This 500+ nmi flight, which flies through an average of 7 en route sectors, has averaged between 81.5 to 82.9 minutes of airborne time over a 12-year period. In 2010 there was a very wide range between the actual airborne time and the of Filed ETE. Can better usage of the forecast close the gap and improve the predictability of the flight ??



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Avg Airborne	81.8	82.6	80.8	82.4	82.4	82.9	82.7	82.5	82.6	81.5	81.8	82.6
Avg Filed ETE	84.2	83.2	81.9	82.8	82.6	86.5	88.7	89.7	85.1	85.2	87.6	82.9
Difference in Average	-2.35	-0.60	-1.13	-0.43	-0.16	-3.61	-6.03	-7.26	-2.52	-3.63	-5.79	-0.35

2010 ORD to DCA

Month	Airborne	FP ETE	FP ETE-Airborne
Jan	81.5	85.9	4.4
Feb	81.8	85.3	3.5
Mar	84.8	88.8	4
Apr	80.6	85.6	5
May	82.4	87.1	4.7
Jun	80.7	86.6	5.9
Jul	82	87.6	5.6
Aug	81.7	88	6.3
Sep	81.1	92.8	11.7
Oct	81.2	92.6	11.4
Nov	82	85	3
Dec	81.5	84.2	2.7

Source: ASPM

User Benefit Perspective

What is Needed to Ensure Defendable Measure of Success?

Legacy Weather Programs

Methodology 1
ITWS BENEFITS
Short-term forecast

Methodology 2
WARP BENEFITS
NEXRAD mosaics

Candidate DSTs Expected to Integrate Weather Forecasts

Methodology 3
CATMT WP2 BENEFITS
CIWS Integration on TSDs

Methodology 4
TBFM BENEFITS
Metering during convective weather

CONSISTENT METRICS that Measure *Incremental Change from Today's State* **are CRITICAL!!**

- En route distance savings
- More efficient capacity utilization
- Increased throughput (surface and airborne)
- Reduced variance in flow separations
- Fewer missed departure slots

NextGen Programs

Methodology 5
NWP BENEFITS
Improved short-term and long-term forecasts

Methodology 6
CSS-WX Benefits
Dissemination of Forecasts

Methodology 7
CATMT WP4 Benefits
Improved Weather Forecast translation impacts Airport Acceptance Rates (AARs)

What Should the FAA be Doing?

- Develop a historical multi-year baseline that captures key measures to track the operational performance in various weather conditions
  - Winter precipitation, IMC, convective weather (terminal, TRACON, en-route), terminal winds, etc.
- Integrate various databases and data sets into a relational database/warehouse that can quickly address the "contribution of the forecast" questions
  - Utilize the National Traffic Management Log (NTML) and sector activity and arrival fix/ departure fix measures better
  - Take advantage of current Weather Impact Traffic Index (WITI) and WITI-Forecast Accuracy (WITI-FA) Toolset and flight data sets, e.g., ASPM, ASQP, OPSNET, PDARS
- Use post-analysis modeling tools to identify opportunities to measure events
- Quantify the impact of enhanced weather capabilities through a *portfolio based Operational Assessment*
  - Provide portfolio views that capture contributions of multiple programs contributing to the *success of the flight* as well as the individual program view
  - Helps assess the results of NextGen Operational Improvements

Questions?