



The Value of a TAF

Southwest Airlines and
NWS Chicago WFO



Southwest

The value of a TAF

- * Joint effort between the LOT NWS WFO and SWA Meteorology to analyze and compare forecasting performance with SWA operational decisions to assign a potential quantitative value to the forecast.
- * Looked at three winter storms in Chicago during late 2013/early 2014.
- * Selected one storm where approximately 50% of flights were cancelled.

Method

- * Compared the TAFs to observations.
- * Scored TAFs for each 6 hour time period.
- * Determined an Airline Operational Category.
- * Compared the TAF 6 and 12 hour period scores to operational activity.
- * Reviewed forecast confidence levels through Area Forecast Discussions.
- * Assigned potential flight value(s)
- * Compared forecast accuracy with flight activity.
- * Calculated forecast values for various flight values.

Airline Operational Criteria

- * Full Operations
 - * Airport above operating minimums
 - * No ATC flight modifications (GDP, GS, miles in trail etc.)
 - * Minimal runway plowing/treatment delays
 - * Minimal Deicing Delays
- * Reduced Operations
 - * Airport above operating minimums
 - * Moderate runway plowing/treatment delays
 - * Limited ATC initiatives.
 - * Low to moderate deicing delays.
- * Limited Operations
 - * Airport brief periods of below (or near below) operating minimums
 - * Frequent runway plowing/treatment delays
 - * Moderate ATC initiatives.
 - * Moderate deicing delays.
- * Suspended Operations
 - * Airport frequently/totally below operating minimums
 - * Significant runway plowing/treatment delays
 - * Significant ATC initiatives.
 - * Significant deicing delays.

Airline Storm Decision Making Process

- * Evaluate and monitor the risk to operations.
- * Size of the risk will determine both the level of involvement, and the number of resources involved.
- * Airline may either:
 - * Cancel total operations
 - * Cancel partial operations
 - * Run tactically – divert and refuel as necessary

Airline Storm Decision Making Process

- * Decision Elements:
 - Airport minimum thresholds
 - Crew duty time
 - Deicing capabilities
 - Airport operations limitations
 - Infrastructure concerns
 - Forecast confidence

Forecast Scoring Criteria

Forecast Points	TAF Precipitation and Visibility elements
1	<ul style="list-style-type: none">• FM Group - 75% correct or greater during TAF duration.
0.75	<ul style="list-style-type: none">• FM Group - 50% correct or greater during TAF duration.• TEMPO group within first 3 hours in error
0.25	<ul style="list-style-type: none">• Between 25 – 50% correct during TAF duration,• FM Group within first 6 hours in error• Forecast of 3 Precipitation Types beyond initial 12 hours of the TAF and didn't occur.
0	<ul style="list-style-type: none">• Less than 25% correct during TAF duration,• If forecast calls for below airport landing minimums (Prevailing or a FM group) within first three hours of the TAF and didn't occur.

TAF Scoring Criteria

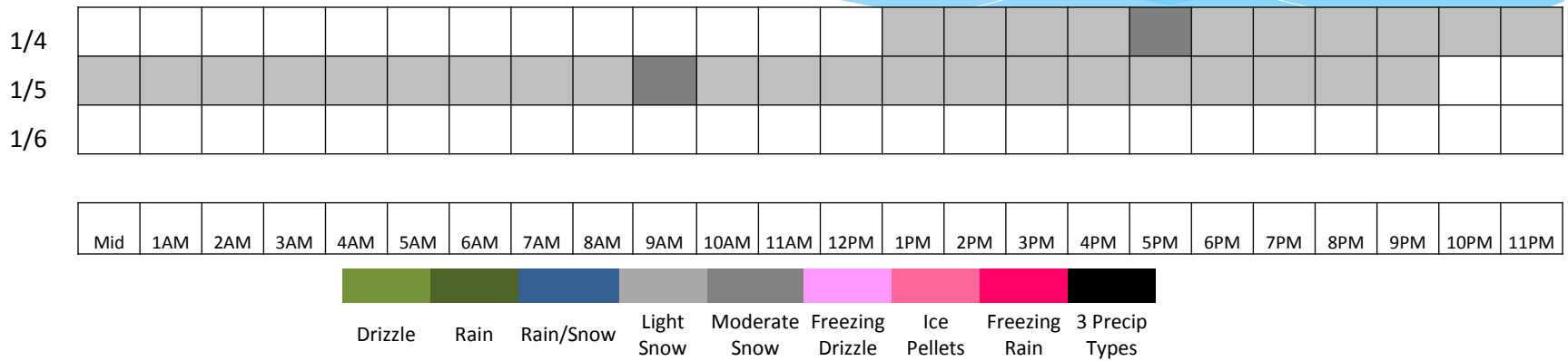
- * TAFs received a 1 if:
 - * Spot on, no matter how far out in time the TAF was put out
 - * TAF forecast a visibility of greater than 1 mile, and actual visibility was greater than 1 mile. (i.e. TAF predicted 4 miles vis., METAR reported 10 miles vis.)
 - * TAF was put out more than 8-12 hours in advance and handled precip. well, regardless of visibility
 - * TAF was more than 12 hours out and was close on precip.
- * TAFs received a .75 if:
 - * Forecast 4-12 hours out and was close with precip. (i.e. -SN vs. -SHSN)
 - * Within 10-12 hours and forecast a visibility of 1 mile or less, when actual visibility ended up being greater than 1 mile.
 - * Within 10-12 hours and forecast a visibility of 1 mile or more, when actual visibility ended up being less than 1 mile.
 - * Within 0-3 hours TEMPO group was forecast at or below 1 mile visibility, when actual visibility ended up being more than 1 mile.
- * TAFs received a 0.5
 - * TAF put out at 0 hours advance notice and handled precip well, but got visibilities 1 mile or less wrong (i.e. TAF indicated a ½ mile vis., and actual vis. was 1 mile.)
 - * Within 0-6 hours FM group was forecast at or below 1 mile visibility, when actual visibility ended up being more than 1 mile.
 - * Was a large block of time (i.e. a 24 hour period) and was either too low or too high (relative to 1 mile) on vis.
- * TAFs received a 0 if:
 - * Within 4 hours and got precip. wrong – not intensity (did or did not occur)
 - * Within 4 hours and predicted a vis. of greater than 1 mile when actual vis. was less than 1 mile.
 - * Within 4 hours and predicted a vis. of less than 1 mile when actual vis. was greater than 1 mile.

Winter Storm 1/3/14 – 1/5/14 Statistics

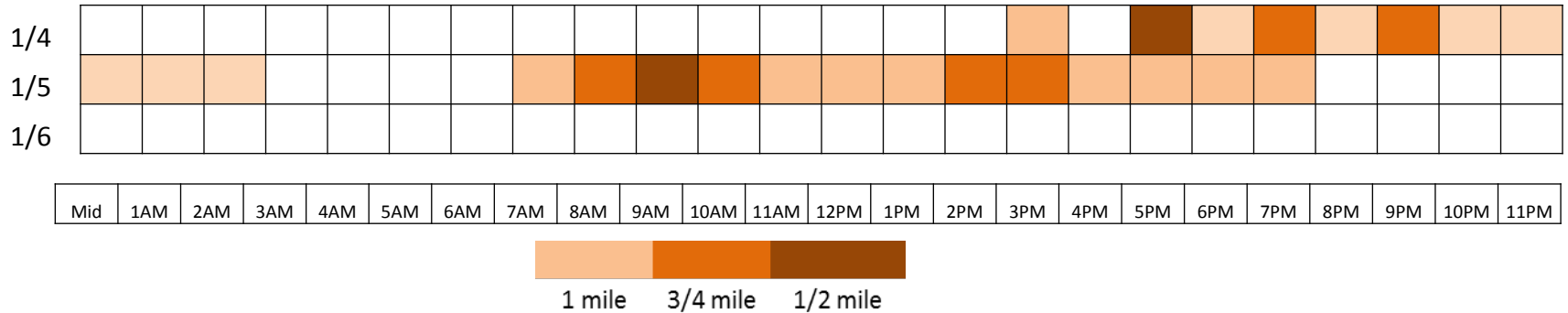
Date	Daily Snowfall	Daily Precipitation	High Temperature	Low Temperature
1/4/2014	2.9	0.26	33	20
1/5/2014	6.7	0.48	31	0

Winter Storm 1/3/14 – 1/5/14 Observations

Precipitation



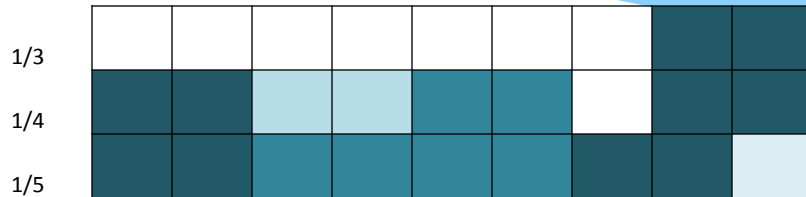
Visibility



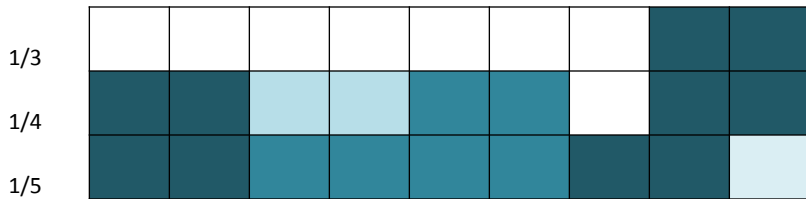
Winter Storm 1/3/14 – 1/5/14

NWS TAF Confidence

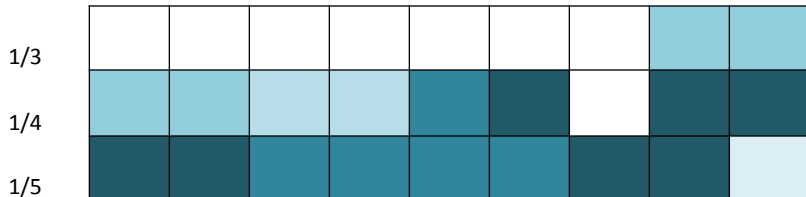
Ceiling



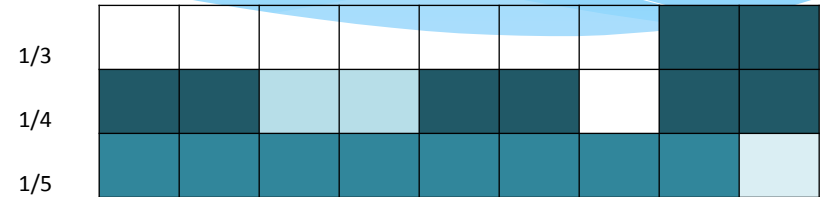
Flight Category



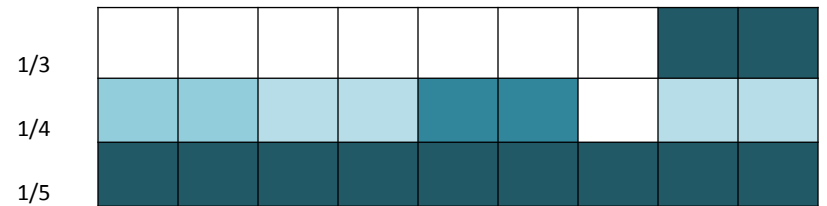
Precipitation



Visibility



Timing



1AM 4AM 7AM 9AM 11AM 1PM 3PM 5PM 7PM 10PM



Low Low/Med Med Med/High High

1AM 4AM 7AM 9AM 11AM 1PM 3PM 5PM 7PM 10PM

Source: AFD



TAF Forecasts and Scores

Fcst Hours	03/2339Z		
	precip	vis	Score
0-6			1
6-12			1
12-18			1
18-24			1

Fcst Hours	04/0239Z		
	precip	vis	Score
0-6			1
6-12			1
12-18			1
18-24			1

Fcst Hours	04/0520Z		
	precip	vis	Score
0-6			1
6-12			1
12-18			1
18-24			1

Fcst Hours	04/0858Z		
	precip	vis	Score
0-6			1
6-12			1
12-18			1
18-24			1

Fcst Hours	04/1125Z		
	precip	vis	Score
0-6			1
6-12			1
12-18			1
18-24			1

Fcst Hours	04/1557Z		
	precip	vis	Score
0-6			1
6-12			1
12-18			1
18-24			1

Fcst Hours	04/1741Z		
	precip	vis	Score
0-6			1
6-12			1
12-18			1
18-24			1

Fcst Hours	04/2126Z		
	precip	vis	Score
0-6			1
6-12			1
12-18			1
18-24			1

Fcst Hours	04/2341Z		
	precip	vis	Score
0-6			0.75
6-12			1
12-18			1
18-24			1

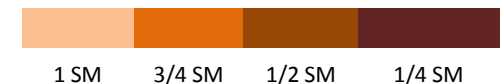
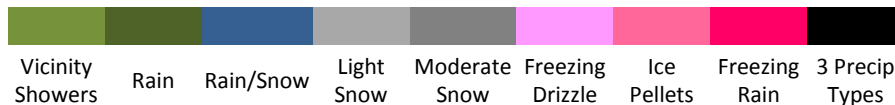
Fcst Hours	05/0307Z		
	precip	vis	Score
0-6			1
6-12			1
12-18			1
18-24			1

Fcst Hours	05/0534Z		
	precip	vis	Score
0-6			0.75
6-12			1
12-18			1
18-24			1

Fcst Hours	05/0902Z		
	precip	vis	Score
0-6			1
6-12			1
12-18			1
18-24			1

Precipitation

Visibility



TAF Forecasts and Scores

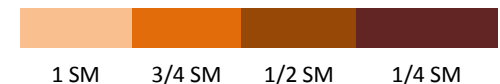
Fcst Hours	05/1122Z			05/1606Z			05/1740Z			05/1932Z		
	precip	vis	Score	precip	vis	Score	precip	vis	Score	precip	vis	Score
0-6	Grey	Brown	1	Grey	Brown	1	Grey	Brown	0.75	Grey	Brown	0.75
6-12	Grey		1	Grey		1			1			1
12-18			1			1			1			1
18-24			1			1			1			1

Fcst Hours	05/2156Z			05/2329Z			06/0318Z		
	precip	vis	Score	precip	vis	Score	precip	vis	Score
0-6	Grey	Orange	1	Grey	Orange	1	Grey		0.75
6-12			1			1			1
12-18			1			1			1
18-24			1			1			1

Precipitation



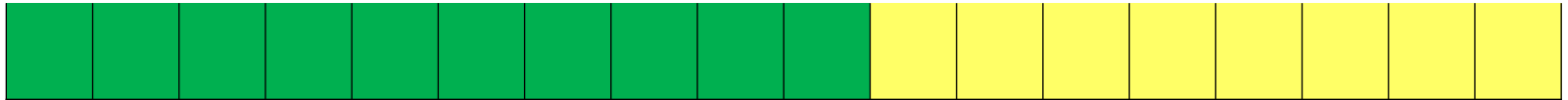
Visibility



Flight Operational Category

1/4/2014

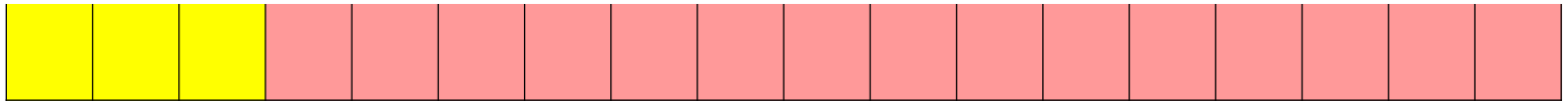
Operational
Flight
Category



5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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1/5/2014

Operational
Flight
Category



5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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Operational Category



Full Reduced Limited Suspended

SWA Flight Operations at MDW

1/4 - 1/5/14

1/4/14

operated	1	5	5	15	10	9	9	6	17	19	12	14	17	10	6	1	1	0
canceled	0	2	0	3	0	1	0	0	0	0	0	1	1	1	0	0	0	0
diverted	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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1/5/14

operated	2	7	4	7	8	4	3	3	5	2	7	11	1	6	5	3	5	0
canceled	1	0	0	6	5	6	10	5	13	7	5	7	9	6	8	5	5	0
diverted	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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Storm Total		
Operated	Cancelled	Diverted
240	107	6

SWA Flight Activity, Precipitation and Visibility

1/4/14

operated	1	5	5	15	10	9	9	6	17	19	12	14	17	10	6	1	1	0
canceled	0	2	0	3	0	1	0	0	0	0	0	1	1	1	0	0	0	0
diverted	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
precip																		
vis																		

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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1/5/15

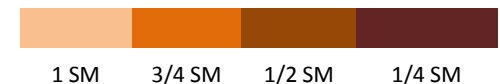
operated	2	7	4	7	8	4	3	3	5	2	7	11	1	6	5	3	5	0
canceled	1	0	0	6	5	6	10	5	13	7	5	7	9	6	8	5	5	0
diverted	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0
precip																		
vis																		

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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Precipitation



Visibility



SWA Flight Activity, Precipitation, Visibility, and Operational Category

1/4/2014

operated	1	5	5	15	10	9	9	6	17	19	12	14	17	10	6	1	1	0
canceled	0	2	0	3	0	1	0	0	0	0	0	1	1	1	0	0	0	0
diverted	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
precip																		
vis																		
Opnl Category																		

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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1/5/2014

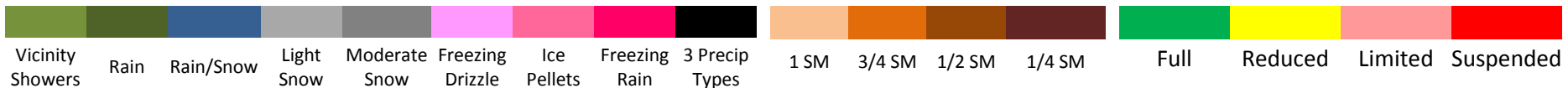
operated	2	7	4	7	8	4	3	3	5	2	7	11	1	6	5	3	5	0
canceled	1	0	0	6	5	6	10	5	13	7	5	7	9	6	8	5	5	0
diverted	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0
precip																		
vis																		
Opnl Category																		

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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Precipitation

Visibility

Operational Category



SWA Flight Activity, Precipitation, Visibility, Operational Category and TAF Scores

1/4/2014

operated	1	5	5	15	10	9	9	6	17	19	12	14	17	10	6	1	1	0
canceled	0	2	0	3	0	1	0	0	0	0	0	1	1	1	0	0	0	0
diverted	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
precip																		
vis																		
Opnl Category																		
TAF 6 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.75
TAF 12 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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1/5/2014

operated	2	7	4	7	8	4	3	3	5	2	7	11	1	6	5	3	5	0
canceled	1	0	0	6	5	6	10	5	13	7	5	7	9	6	8	5	5	0
diverted	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0
precip																		
vis																		
Opnl Category																		
TAF 6 hr Score	0.75	0.75	1	1	1	1	1	0.75	0.75	0.75	0.75	0.75	1	1	1	1	0.75	0.75
TAF 12 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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Precipitation

Visibility

Operational Category



Forecast Value at \$1500/flight

1/4/2014

operated	1	5	5	15	10	9	9	6	17	19	12	14	17	10	6	1	1	0
canceled	0	2	0	3	0	1	0	0	0	0	0	1	1	1	0	0	0	0
diverted	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
precip																		
vis																		
Opnl Category																		
TAF 6 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.75
TAF 12 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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1/5/2014

operated	2	7	4	7	8	4	3	3	5	2	7	11	1	6	5	3	5	0
canceled	1	0	0	6	5	6	10	5	13	7	5	7	9	6	8	5	5	0
diverted	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0
precip																		
vis																		
Opnl Category																		
TAF 6 hr Score	0.75	0.75	1	1	1	1	1	0.75	0.75	0.75	0.75	0.75	1	1	1	1	0.75	0.75
12 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Fcst Val 6 hr				19500	19500	15000	19500	9000	20250	10125	13500	20250	15000	18000	19500	12000	11250	0
Fcst Val 12 hr				19500	19500	15000	19500	12000	27000	13500	18000	27000	15000	18000	19500	12000	15000	0

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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Forecast Value at \$1500/flight

1/4/2014

operated	1	5	5	15	10	9	9	6	17	19	12	14	17	10	6	1	1	0
canceled	0	2	0	3	0	1	0	0	0	0	0	1	1	1	0	0	0	0
diverted	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
precip																		
vis																		
Opnl Category																		
TAF 6 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.75
TAF 12 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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1/5/2014

operated	2	7	4	7	8	4	3	3	5	2	7	11	1	6	5	3	5	0
canceled	1	0	0	6	5	6	10	5	13	7	5	7	9	6	8	5	5	0
diverted	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0
precip																		
vis																		
Opnl Category																		
TAF 6 hr Score	0.75	0.75	1	1	1	1	1	0.75	0.75	0.75	0.75	0.75	1	1	1	1	0.75	0.75
12 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Fcst Val 6 hr				19500	19500	15000	19500	9000	20250	10125	13500	20250	15000	18000	19500	12000	11250	0
Fcst Val 12 hr				19500	19500	15000	19500	12000	27000	13500	18000	27000	15000	18000	19500	12000	15000	0

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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6 Hour TAF Value \$222,375

12 Hour TAF Value \$250,500

Forecast Value at \$500/flight

1/4/2014

operated	1	5	5	15	10	9	9	6	17	19	12	14	17	10	6	1	1	0
canceled	0	2	0	3	0	1	0	0	0	0	0	1	1	1	0	0	0	0
diverted	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
precip																		
vis																		
Opnl Category																		
TAF 6 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.75
TAF 12 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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1/5/2014

operated	2	7	4	7	8	4	3	3	5	2	7	11	1	6	5	3	5	0
canceled	1	0	0	6	5	6	10	5	13	7	5	7	9	6	8	5	5	0
diverted	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0
precip																		
vis																		
Opnl Category																		
TAF 6 hr Score	0.75	0.75	1	1	1	1	1	0.75	0.75	0.75	0.75	0.75	1	1	1	1	0.75	0.75
TAF 12 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Fcst Val - 6 hr				6500	6500	5000	6500	3000	6750	3375	4500	6750	5000	6000	6500	4000	3750	0
Fcst Val - 12 hr				6500	6500	5000	6500	4000	9000	4500	6000	9000	5000	6000	6500	4000	5000	0

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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6 Hour TAF Value \$74,125

12 Hour TAF Value \$83,500

Forecast Value at \$2500/flight

1/4/2014

operated	1	5	5	15	10	9	9	6	17	19	12	14	17	10	6	1	1	0
anceled	0	2	0	3	0	1	0	0	0	0	0	1	1	1	0	0	0	0
diverted	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
precip																		
vis																		
Opnl Category																		
TAF 6 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.75
TAF 12 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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1/5/2014

operated	2	7	4	7	8	4	3	3	5	2	7	11	1	6	5	3	5	0
anceled	1	0	0	6	5	6	10	5	13	7	5	7	9	6	8	5	5	0
diverted	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0
precip																		
vis																		
Opnl Category																		
TAF 6 hr Score	0.75	0.75	1	1	1	1	1	0.75	0.75	0.75	0.75	0.75	1	1	1	1	0.75	0.75
TAF 12 hr Score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Fcst Val - 6 hr				32500	32500	25000	32500	15000	33750	16875	22500	33750	25000	30000	32500	20000	18750	0
Fcst Val - 12 hr				32500	32500	25000	32500	20000	45000	22500	30000	45000	25000	30000	32500	20000	25000	0

5AM	6AM	7AM	8AM	9AM	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	10PM
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6 Hour TAF Value \$370,625

12 Hour TAF Value \$417,500

Summary

- * TAFs have significant value in airline strategic planning decisions.
- * TAFs can be (should be?) “scored” based on potential impact to operations.
- * Airline decisions are based on both the confidence and elements of the forecast.