Automation to Support Strategic Traffic Flow Management

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Strategic TFM Planning for Weather

Probabilistic forecasts identify regions of potential weather activity

Short Range Ensemble Forecast (SREF) for 28 July, 2014

What is the range and likelihood of different weather scenarios occurring?

What are the potential scenarios of ATM impacts?

What options are available to mitigate congestion and when do we have to act?
Automation to Assist TFM Planning: Flow Contingency Management (FCM)

FCM aims to provide a *scientific* methodology for strategic TFM decision-making

Developing a common understanding of the problem among stakeholders

Providing a quantitative analysis of potential plans *prior* to implementation

Enabling fact-based discussions for strategic planning development
FCM Capabilities
Quantify TFM Impact

Capacity Prediction

- Ensemble weather forecast
- Predict Airspace Capacity
- Demand Prediction
- Simulate Traffic
- Demand forecast
- Flight plans
- Historical traffic
- Implemented TMI

Demand Prediction

- Weather forecast
- Capacity Scenarios
- Predict Airport Capacity
- Airport Demand
- Sector and Airspace congestion shown as increasing darker colors
Quantify TFM Impact
Predict Capacities

Predict Airspace Capacity


Predict Airport Capacity
Joint MITRE/WSU Research

- Demand
- Staffing, Time-of-day, maintenance, operator’s choice, etc...

Runway Configuration Selection
LAT: Strategic (Hours to Days)

- Wind Speed and Direction
- Visibility, ceiling (meteorological conditions or MC)

Tactical TRACON operations
(spacing, scheduling of runway use, airspace traffic patterns)
LAT: Tactical (Couple of hours)

Convective Weather

Airport or Approach Closure
LAT: Tactical (Minutes to an hour)

Capacity
AAR/ADR

Capacity Scenarios
Quantify TFM Impact
Generate Weather Impact Scenarios

Capacity Scenarios

Simulate Traffic

Congestion Forecast

Cluster Scenarios

Clustering Process
• Identify critical forecast features
• Evaluate scenarios for similarities
• Cluster scenarios on diverging features over forecast time

Weather Impact Scenarios

1200Z 1400Z 1600Z

Planning Horizon

Demand forecast

10% 10% 10% 10%

90% 80%
FCM Capabilities

Leverage Historical TMIs

- Ensemble weather forecast
- Flight plans
- Historical traffic
- Implemented TMIs
- Historical Events

Capacity Scenarios

Simulate Traffic

Demand forecast

Weather Impact Forecast

Identify Historical TMIs

Historical TMI Options

Match 1: GDPs, AFPs
Match 2: GDPs
Match 3: Reroutes
Leverage Historical TMIs
Classify Similar Events

**Historical Event Database**
- Forecasted weather
- Actual weather
- Forecasted demand
- Track data
- Planned TMIs
- TMI Revisions
- Performance goals
- Performance measure

**Historical Features**
- Location of impact
- Timing of congestion
- Severity of Congestion
- Any attribute that signals TMIs
Leverage Historical TMIs

Identify Historical TMI Options

Weather Impact Scenarios

Classify Features

Identify Historical TMIs

Feature-TMI Groupings

Evaluation by automation

Historical Options Set

Historical TMI Options

Restriction | Start Time | Duration | Rate
---|---|---|---
Ground Delay | 15:00-23:00 | 2-6 hours | 25-40 /hr
Meter Point | 15:00-23:00 | 2-4 hours | 10-40 /hr
Reroute | 17:00-20:00 | 2-8 hours |
FCM Capabilities

Generate and Evaluate TMI Plans

- Ensemble weather forecast
- Flight plans
- Historical traffic
- Implemented TMI plans
- Historical events

Capacity Scenarios

Simulate Traffic

- Demand forecast

Weather Impact Forecast

Identify Historical TMI plans

Generate TMI Options

Proposed Strategy

Option Set Goals

TMI Performance

[many times]

[automation-assisted design]

[manual “what-if”]

Performance
Generate and Evaluate TMI Plans

“What-if” Analysis

Weather Impact Scenarios

1200Z 1400Z 1600Z

Planning Horizon

Historical TMI Options

Match 1: GDPs, AFPs
Match 2: GDPs
Match 3: Reroutes

Simulate Traffic

Airspace Control at 21:00Z
Airspace Control at 23:00Z

Performance

Proposed Strategy
Generate and Evaluate TMI Plans

Design TMI Plan Options

### Historic Options Set

<table>
<thead>
<tr>
<th>Restriction</th>
<th>Start Time</th>
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<th>Rate</th>
</tr>
</thead>
<tbody>
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### Weather Impact Scenarios

- **1200Z**: 10%
- **1400Z**: 90%
- **1600Z**: 10%

### TMI Plan

- **Scenario 1** Possible Restrictions
- **Scenario 2** Possible Restrictions
- **Scenario 3** Possible Restrictions

### Generate TMI Options

- Select TMI Parameters
- Simulate Traffic
- Evaluate Objectives

### TMIs Performance

- Goals

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Discussion

- FCM takes the strategic planning process from *reactive* to *proactive*
  - Analyze problems *before* they start
  - Develop mitigation strategies based on *analytical* evaluation
  - Opportunity to evolve the decision making paradigm

- Automation can help identify problems and develop solutions
  - Quantify capacity impacts
  - Gain insight from historical information
  - Generate and evaluate solutions

- Success means a more efficient, more repeatable, and more transparent TFM system
Thanks!
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