Assessing the NextGen Avionics Business Case from the Airline Perspective

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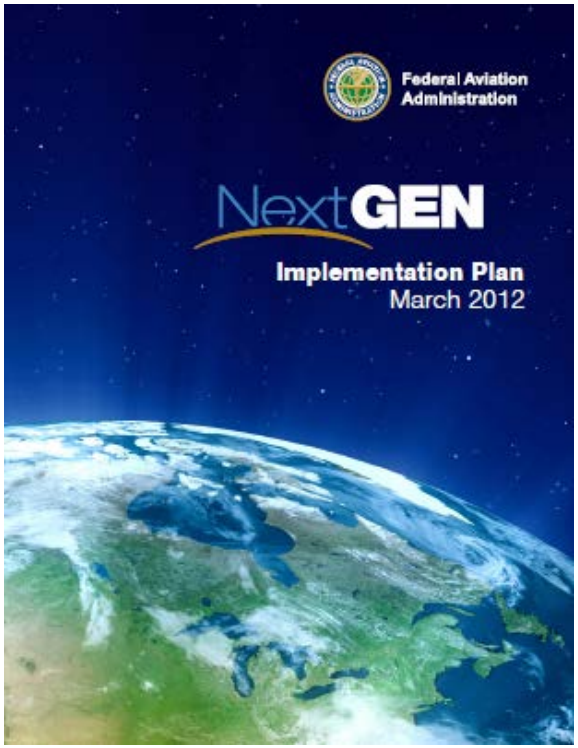
Outline of Presentation

- **Context**
- **Problem statement**
- **MITRE research**
  - Airline interviews
  - Airline regression analysis
- **Summary and Conclusions**

The Next Generation Air Transportation System (NextGen)



- ***Is a transformative change in the management and operation of how we fly***
- ***Enhances safety, reduces delays***
- ***Integrates new and existing technologies, including satellite navigation and advanced digital communications****
- ***Is a joint investment between FAA and aircraft operators***
  - Key enabling avionics include ADS-B (Out, In), Data Communications, Performance-Based Navigation

Source: NextGen Implementation Plan, Federal Aviation Administration, March 2012.

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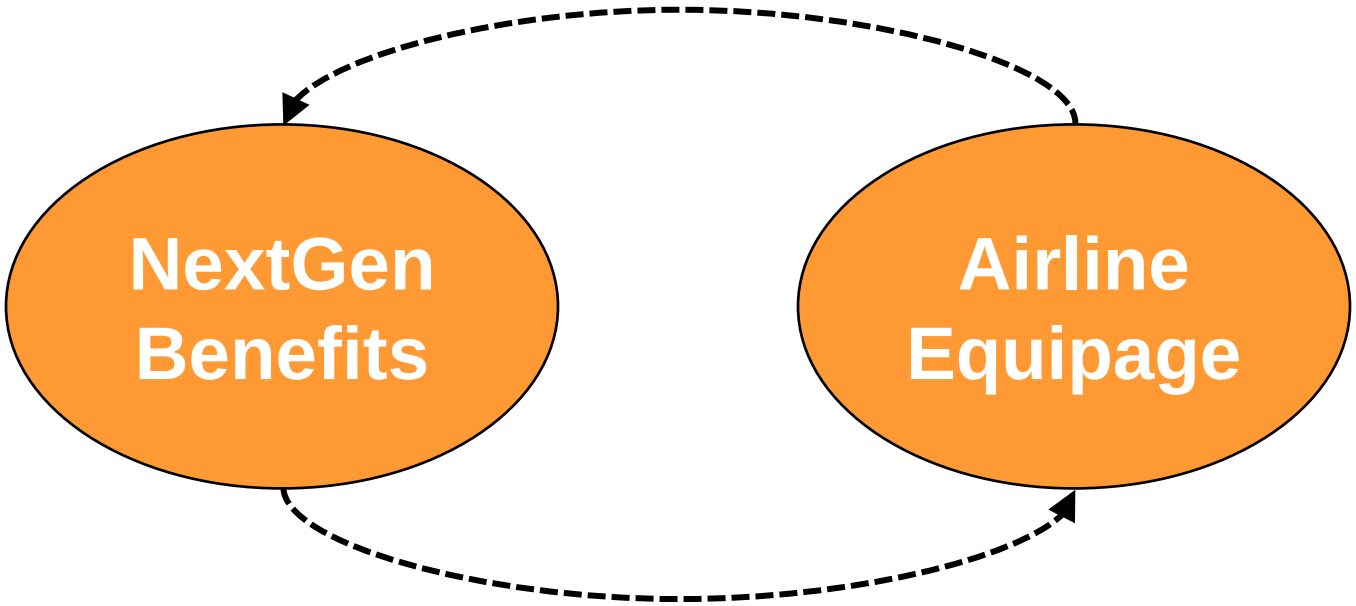
The NextGen Equipage Dilemma

Benefits require airline participation…



…but airlines won't participate without clear, credible, and relevant benefits!

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Shortfalls of Conventional Cost Benefit Analysis for Airline Business Cases

Assumptions*

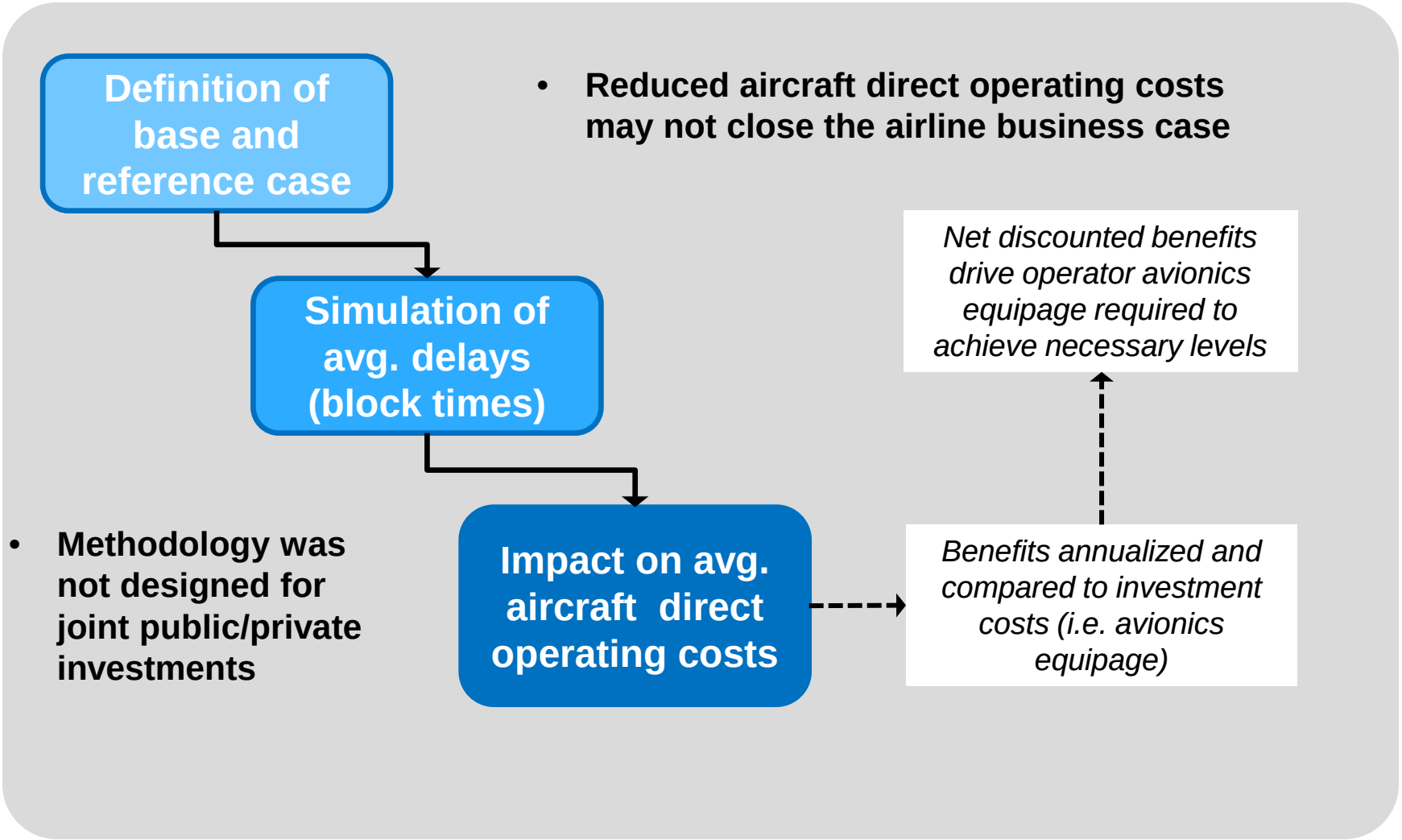
- Lack of specific, forecasted benefits to equipped users
- Uncertainty about future FAA capability implementation plans by specific time and location
- Benefit lag undermines business case

Methodology

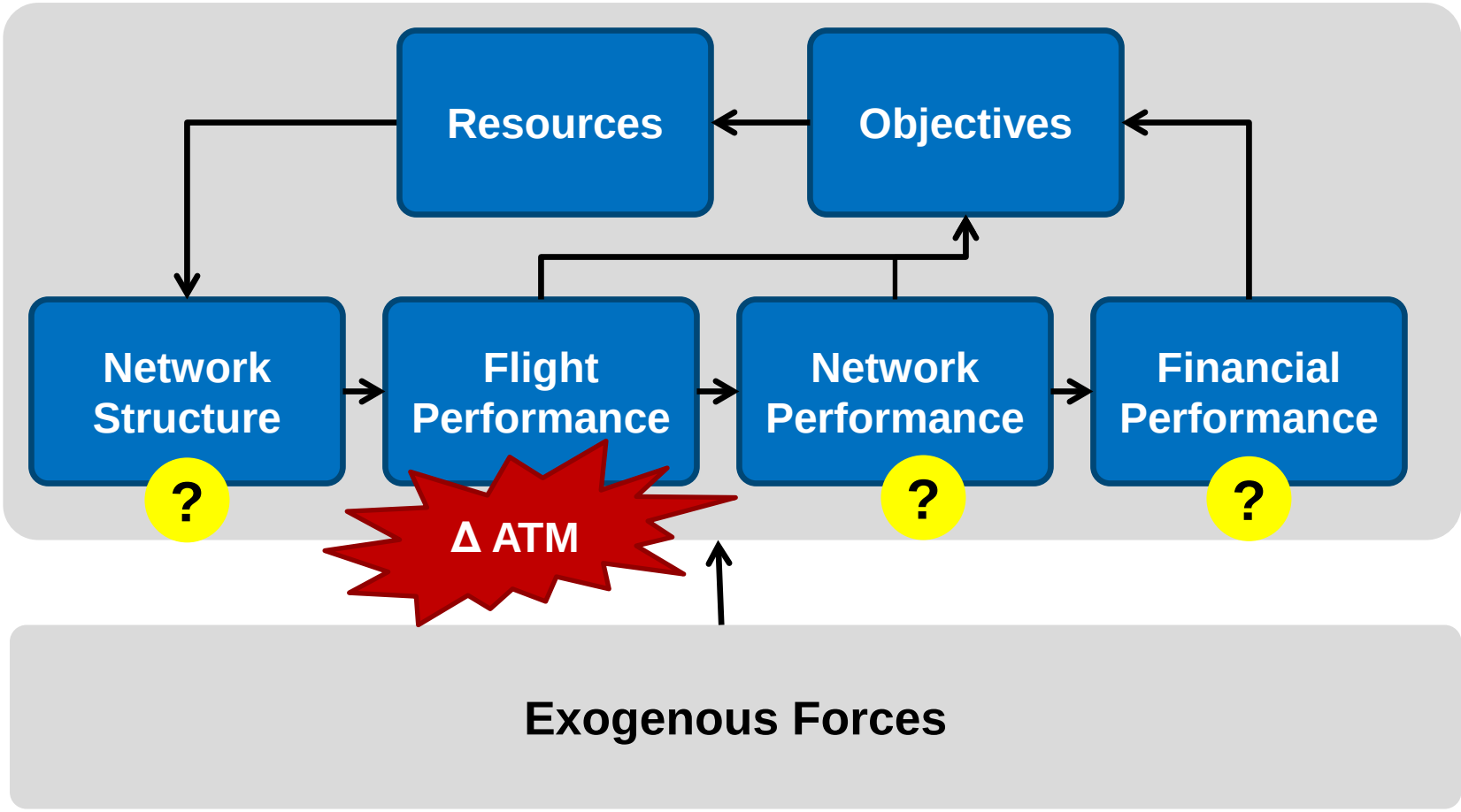
- Level of granularity is too high to be actionable
- Delay savings are only part of the impact story
- Averages mask underlying distributions
- Airlines respond to changes in their environment, and value potential opportunities accordingly

*Source: NextGen Equipage: User Business Case Gaps, RTCA, September 2011.

Cost Benefit Analysis of FAA Investments (Simplified View)



Airlines Operate in a Dynamic Environment



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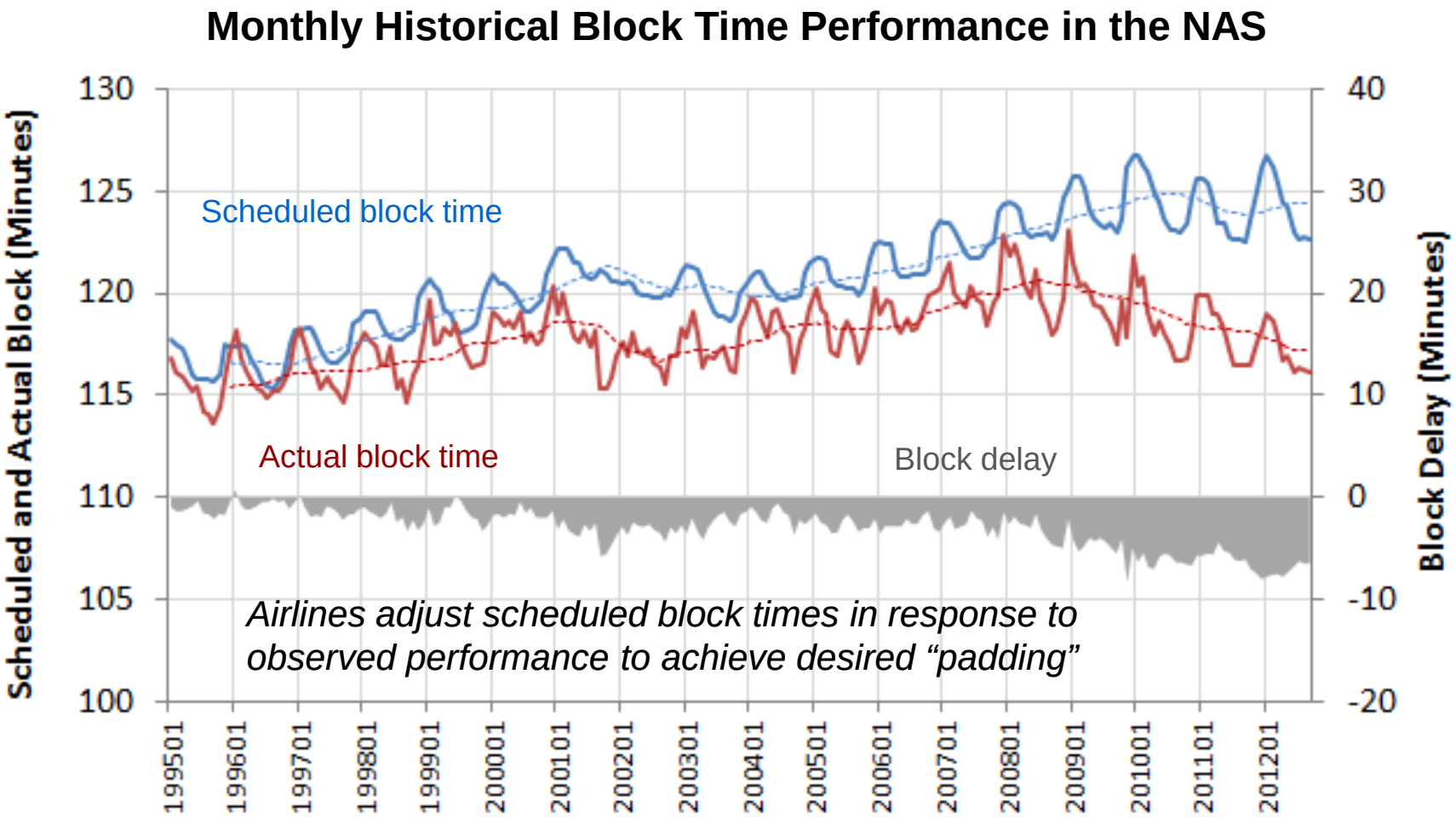
MITRE Research: Aviation Policy Trade Space

- **Research purpose:**
  - Advance the implementation of NextGen through insight that promotes the mutual understanding of its likely impact and value from the perspective of its stakeholders
- **Research focus in FY11:**
  - Explore financial and operational incentives
- **Research focus in FY12:**
  - A better understanding of airline behavior and performance in response to (and anticipation of) changes in the NAS
- **Overarching research questions:**
  - *How do airlines respond to changes in their operating environment?*
  - *How does airline response affect financial performance?*
  - *How do airlines evaluate and perceive investment opportunities in light of this?*

Example of Airline Response: Scheduled Block Time



Source: DOT Airline Service Quality Performance (ASQP) data. Series adjust for changes in fleet mix and airport-pairs over time.

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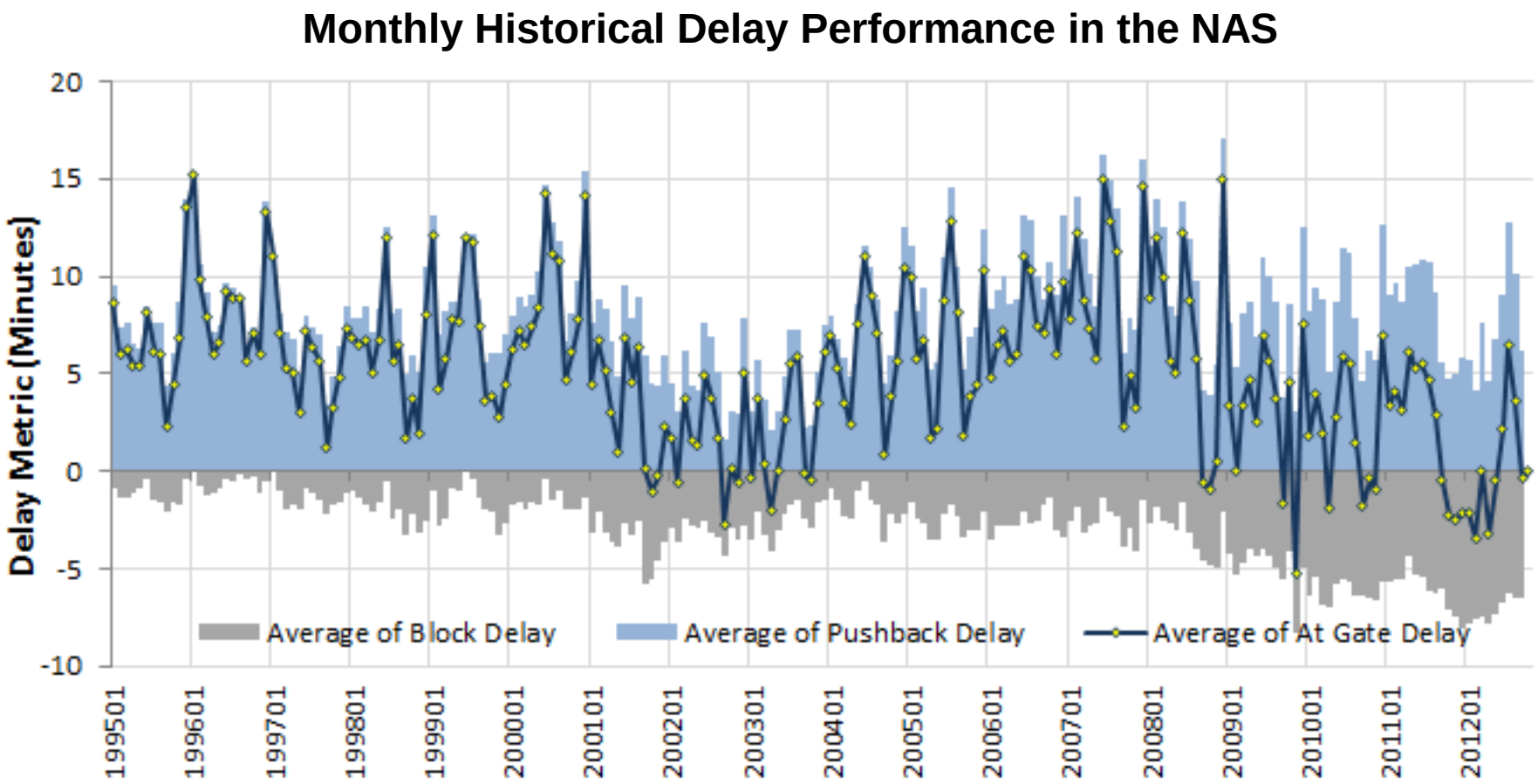
Airline Block Time Padding Affects Arrival Performance



Source: DOT Airline Service Quality Performance (ASQP) data. Series adjust for changes in fleet mix and airport-pairs over time.

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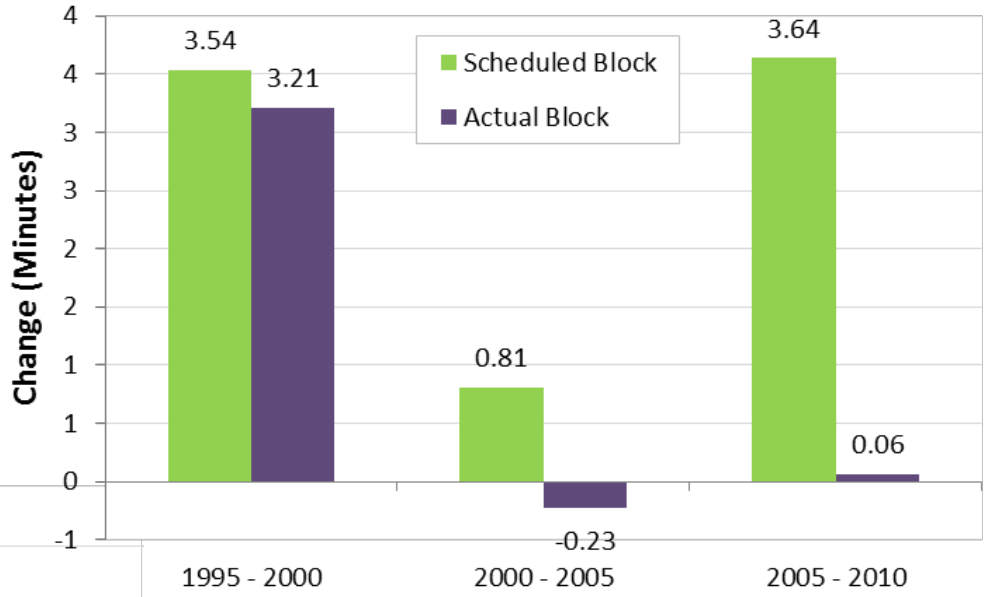
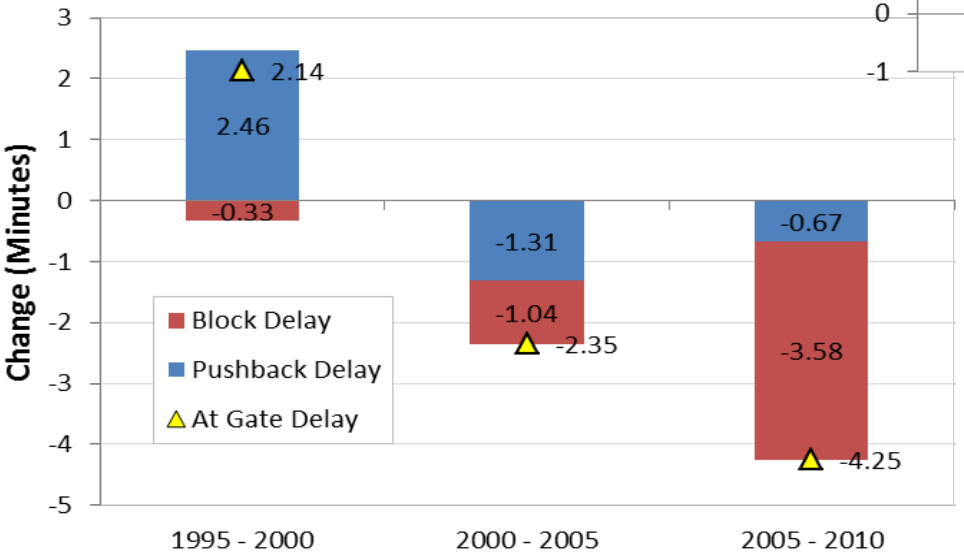
Airline Block Time Padding Affects Arrival Performance

- **Decrease in avg. at gate arrival delay from 2005 to 2010 was driven by block delay (scheduled - actual block time)**





- **Decrease in block delay for the same period was the *result of increased scheduled block time***

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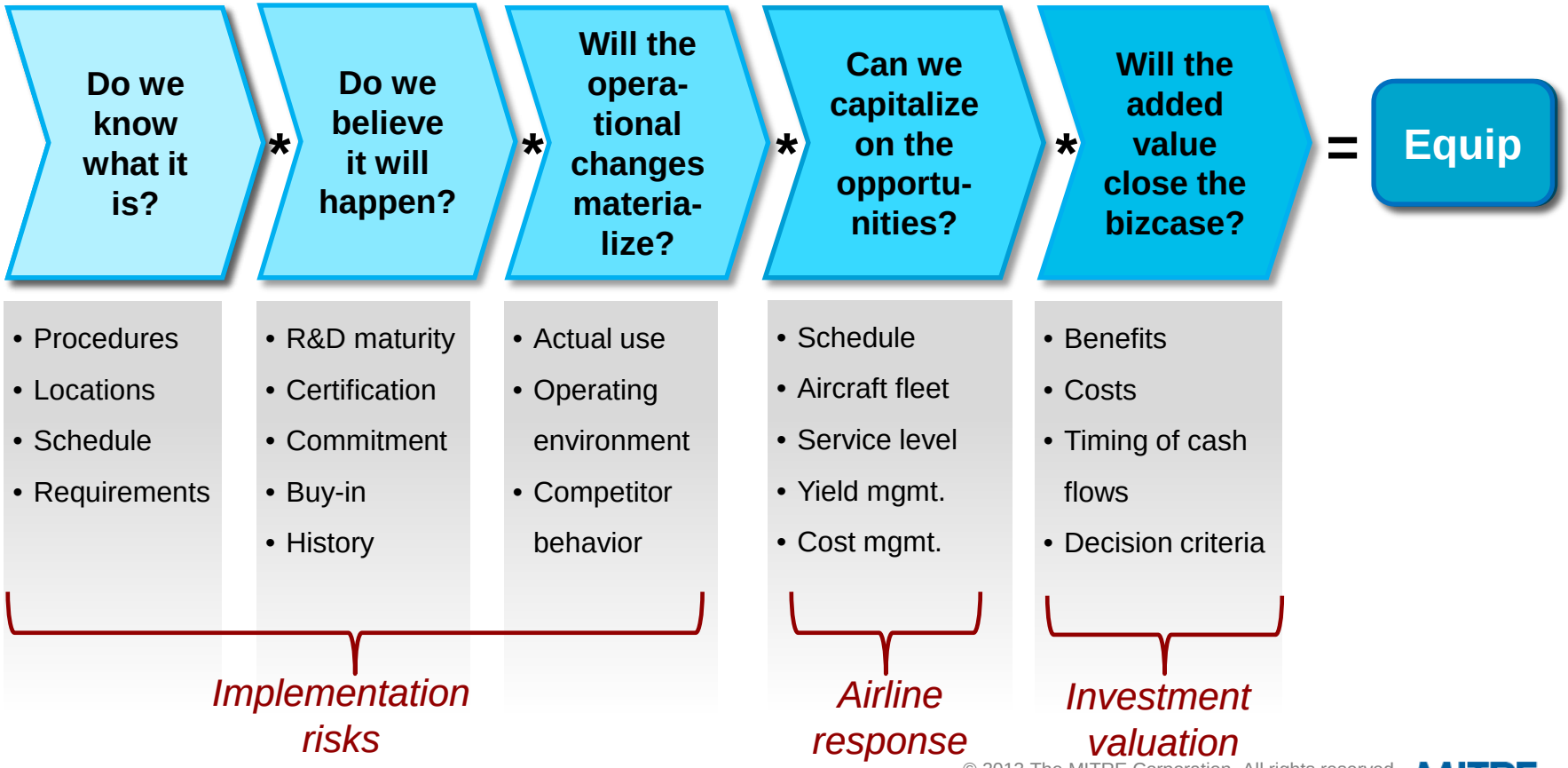
Airline Interviews in FY12

- **Conducted site visits with three airlines**
  - Built on extensive discussions in FY11
  - Met with senior managers in scheduling, finance, strategy, ATM, operations, and analysis
- **Purpose was to enhance understanding of:**
  - Airline decision-making considerations, valuations and processes
  - NextGen perspectives
  - Impact of changes in operational performance

Airline Motivation Framework

- **We decomposed the drivers of airline investment decisions to isolate business case gaps**



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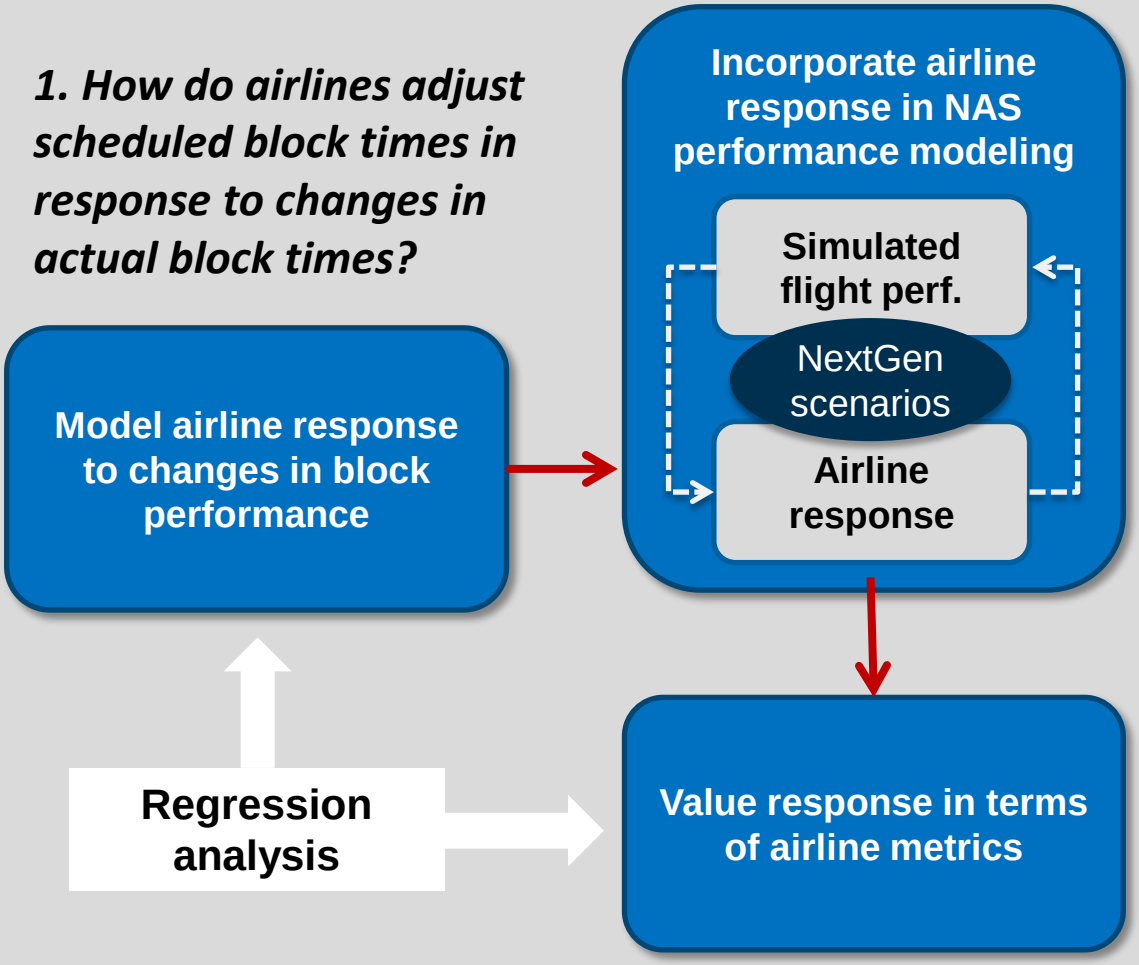
Key Themes from Airline Interviews

- **Implementation risks are significant**
  - Risk aversion is the norm
  - Long-term benefit perspective almost irrelevant
- **Delay savings are only part of the story**
  - Goal is to optimize the schedule to maximize profit
  - Each airline will evaluate opportunities in terms of its own operations and circumstances
- **Operational predictability is a key—will improvements allow airlines to "do more with less?"**

Analysis Questions in the Context of Implementation Design

1. How do airlines adjust scheduled block times in response to changes in actual block times?



2. How does airline response assumption change the operational impact story?

3. How would such adjustments impact airline operational and financial performance?

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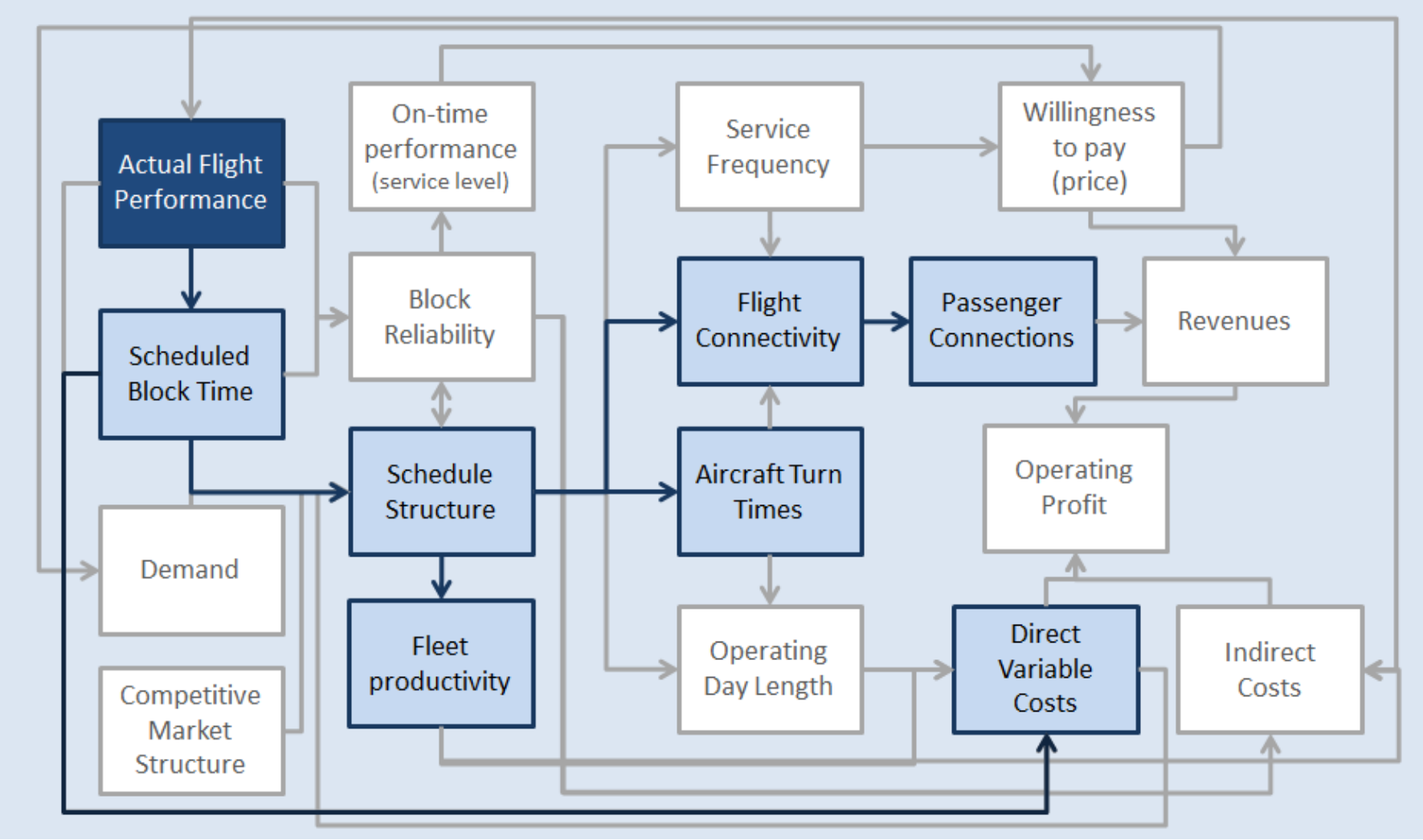
Regression Analysis

- **Purpose**
  - Quantify relationship between scheduled and actual block times (airline response) for individual airlines
  - Test and isolate impact of scheduled block time response on operational and financial airline metrics
- **Scope**
  - 8 ASQP Carriers*
  - 1998 Q1 – 2011 Q3 (maximum of 55 quarters)
  - Domestic operations (due to data limitations)
- **Fused data sources**
  - Airline block time performance data: ASQP
  - Airline financial and activity data: DOT Form-41 reports

*American Airlines, American Eagle, Delta Airlines, JetBlue Airlines, Northwest Airlines, Southwest Airlines, United Airlines, US Airways.

Airline Value Chain Framework

(Developed to test relationships)



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Multivariate Regressions

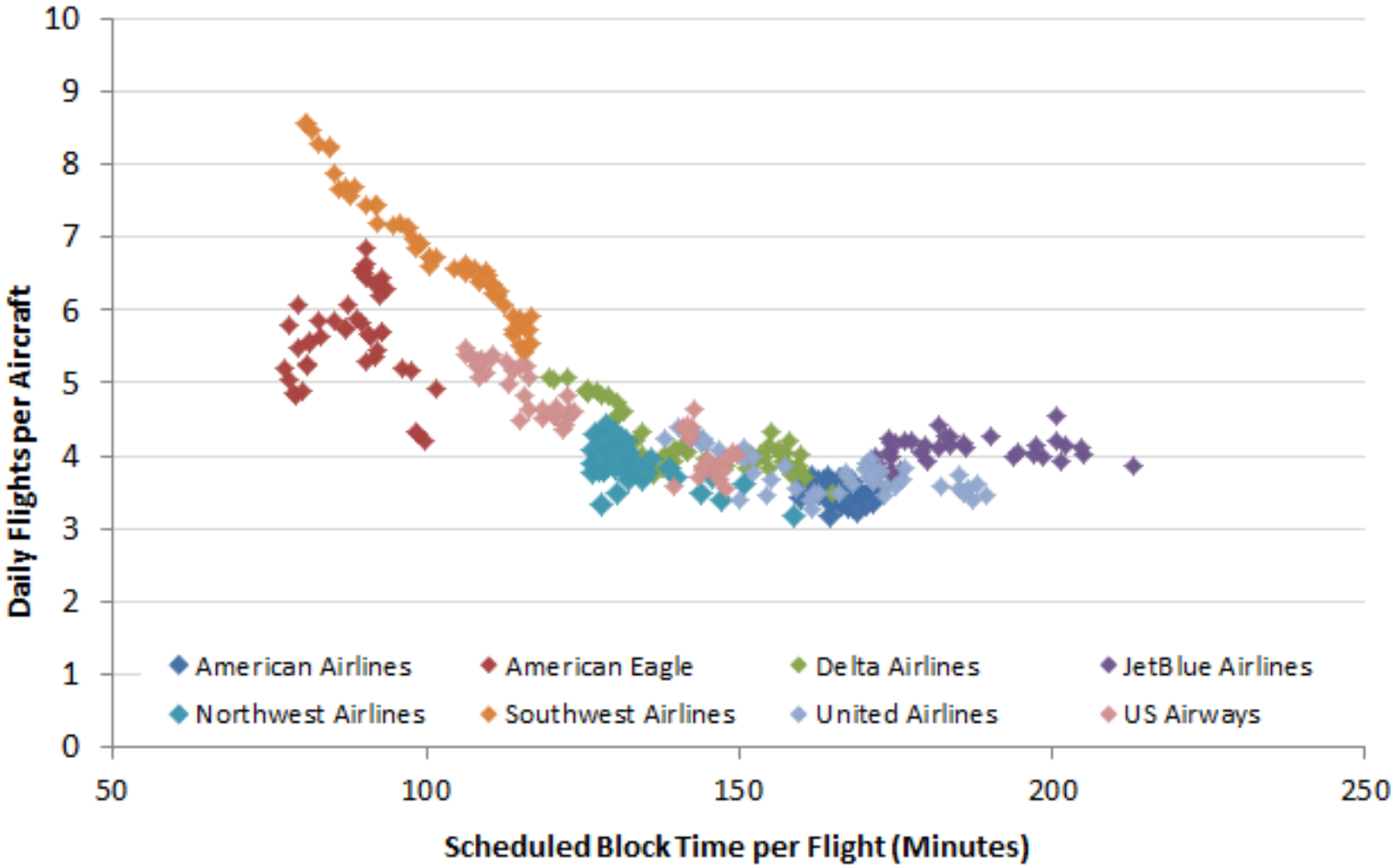
- **Ordinary least squares (OLS) linear regressions**
- **Used first-differences ($X_t - X_{t-1}$) for all variables:**

$$\Delta Y_t = \beta_1 \Delta X_{1t} + \beta_2 \Delta X_{2t} + \ldots \beta_k \Delta X_{kt} + e$$

- **Key relationships tested, by airline** ($\Delta Y = f(\Delta X)$):
  - *Scheduled block time = f (Actual block time)*
  - *Scheduled block time = f (Actual flight time)*
  - *Daily flights per aircraft = f (Scheduled block time)*
  - *Daily flights per aircraft = f (Scheduled turn time)*
  - *Daily possible aircraft connections = f (Scheduled block time)*
  - *Quarterly connecting passengers = f (Daily possible aircraft connections)*
  - *Pilot salary per mile = f (Scheduled block time per mile)**

* Results are excluded from this presentation.

Example of Different Airline Models: Daily Aircraft Utilization (1998 – 2011)



Source: DOT Airline Service Quality Performance (ASQP) data.

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Results: Regression Coefficients for Relationships of Interest

Legend

Coefficient

[# Variables; Adj. R^2]

Empty cells indicate that no statistical relationship was observed between explanatory variable of interest and the dependent variable

Δ in Dependent Variable	Δ in Explanatory Variable of Interest	American Airlines	American Eagle	Delta Airlines		JetBlue Airways	Northwest Airlines	Southwest Airlines	United Airlines	US Airways	
				All Periods	Pre-Merger[1]					All Periods	Pre-Merger[2]
Avg. Scheduled block time	Avg. Actual block time	**0.75** [3; 0.73]	**0.75** [1; 0.66]	**0.91** [2; 0.67]	**0.83** [2; 0.54]	**0.90** [1; 0.86]	**0.80** [2; 0.74]	**0.78** [2; 0.76]	**0.62** [2; 0.58]	**0.89** [1; 0.81]	**0.89** [1; 0.83]
Avg. Scheduled block time	Avg. Actual flight time	**0.96** [2; 0.81]	**0.99** [2; 0.74]	**1.12** [2; 0.78]	**1.07** [2; 0.71]	**0.96** [2; 0.90]	**1.26** [2; 0.81]	**0.70** [2; 0.76]	**0.70** [2; 0.66]	**1.05** [2; 0.90]	**1.04** [2; 0.91]
Avg. Daily flights per aircraft	Avg. Scheduled block time	**-0.02** [3; 0.33]		**-0.02** [2; 0.38]	**-0.02** [2; 0.28]		**-0.05** [2; 0.40]		**-0.02** [2; 0.34]		
Avg. Scheduled aircraft turn time	Avg. Scheduled block time			**-0.15** [2; 0.17]	**-0.34** [2; 0.36]						
Avg. Daily flights per aircraft	Avg. Scheduled aircraft turn time	**-0.02** [3; 0.33]	**-0.11** [2; 0.33]			**-0.03** [2; 0.20]	**-0.08** [2; 0.40]		**-0.03** [2; 0.34]	**-0.05** [2; 0.26]	**-0.05** [2; 0.28]
Daily possible aircraft connections	Avg. Scheduled block time		**-491.31** [2; 0.86]	**-2016.21** [2; 0.76]	**-1158.17** [2; 0.91]			**-545.75** [2; 0.93]			
Quarterly connecting passengers	Daily possible aircraft connections	**4.8** [2; 0.61]	**5.6** [2; 0.46]	**18.7** [2; 0.69]	**1.17** [2; 0.66]	**32.9** [2; 0.46]	**10.3** [3; 0.73]	**58.0** [1; 0.33]	**7.4** [3; 0.83]		
Avg. Pilot salary per available seat mile (real)	Avg. Scheduled block time	**6.4E-5** [1; 0.13]					**8.2E-5** [2; 0.13]	**6.7E-5** [1; 0.11]			

1. Data series ends prior to incorporation of Northwest Airlines data under Delta name in 2010. 2 . Data series ends prior to incorporation of America West data under US Airways name in 2007.

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Summary and Conclusions

- **To achieve benefits of the *joint* NextGen investment:**
  - Operators need some certainty in implementation schedules and operational impacts
  - Need to understand how individual operators consume impacts
    - Data analysis shows promise and limitations
- **An understanding of the likely business impact from an airline perspective will inform program and policy decisions and maximize NextGen success**
- **More research is needed to integrate airline dynamic response into benefit analyses to understand likely investment behaviors and resulting system impacts**
  - Continue to understand how this would improve insights
  - Expand beyond airline community to other stakeholders

Backup

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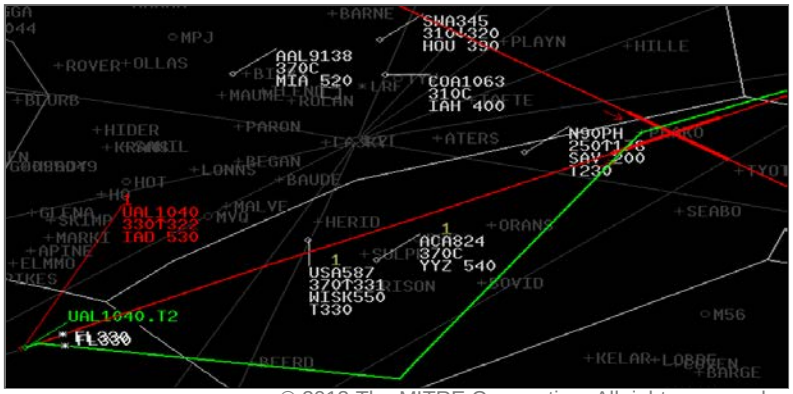
Our Mission:

To serve the public interest by advancing the safety, security, effectiveness, and efficiency of aviation in the United States and around the world by conducting a continuing program of research, development, and engineering in collaboration with the aviation community



RTCA Business Case and Performance Metrics Working Group Report

- **To increase user confidence in equipage business cases, FAA should:**
  - Develop estimates of the direct benefits for users equipping with NextGen avionics in conjunction with affected operators
  - Establish a stable, long-term implementation plan for each capability requiring a critical mass of installed avionics to achieve user or societal benefits
- **To close user business case gaps for capabilities with positive (net) system and societal benefits, FAA should:**
  - Work with the aviation community to better understand the business case for bundled equipage options
  - Offer incentives for early adopters where a critical mass is needed and to stimulate user forward-fit and retrofit decisions

*Source: NextGen Equipage: User Business Case Gaps, RTCA, September 2011.

Acknowledgments

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