Flight and Passenger Delays

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Industry Advisory Board/ Airline Industry Consortium Joint Meeting

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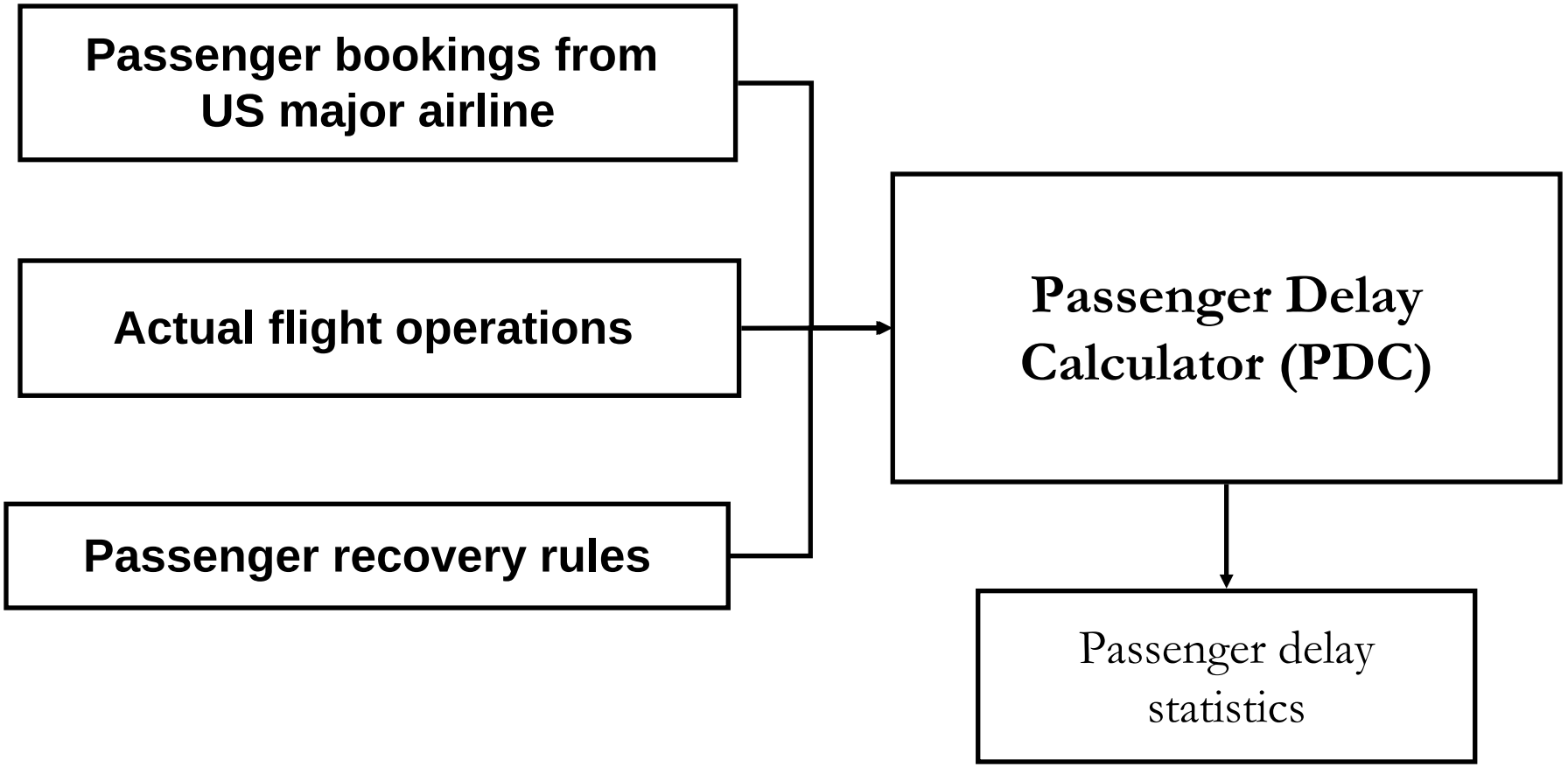
Outline

- Passenger vs. Aircraft Delays
  - Estimate passenger booking data
  - Case Study: Contrast relationship between aircraft and passenger delays
    - Illustrate for two airlines
      - Legacy, hub-and-spoke network (banked hubs)
      - Low-cost, point-to-point (with de-banked ‘hubs’)
    - On two days
      - A ‘good weather’ (low delay) day
      - A ‘bad weather’ (high delay) day
    - Evaluate the impact of different flight networks and scheduling practices on the resulting passenger and aircraft delays
- Describe ongoing work

Passenger Delay Calculator



Flight Delays Typically Underestimate Passenger Delays

Sample Day	Av. Delay	% Delays	% Pax
Disrupted pax	7 hours	61%	4%
Non disrupted pax	14 minutes	39%	96%
All pax	28 minutes		
Flights	16 minutes		

Performance Metrics

Day	15OTP(*)	Av. Passenger Delay (minutes)
Day 17	84.0%	21.8
Day 18	76.8%	20.1

- Relative flight delays between flights within a bank are more important than absolute delays with respect to passenger disruptions

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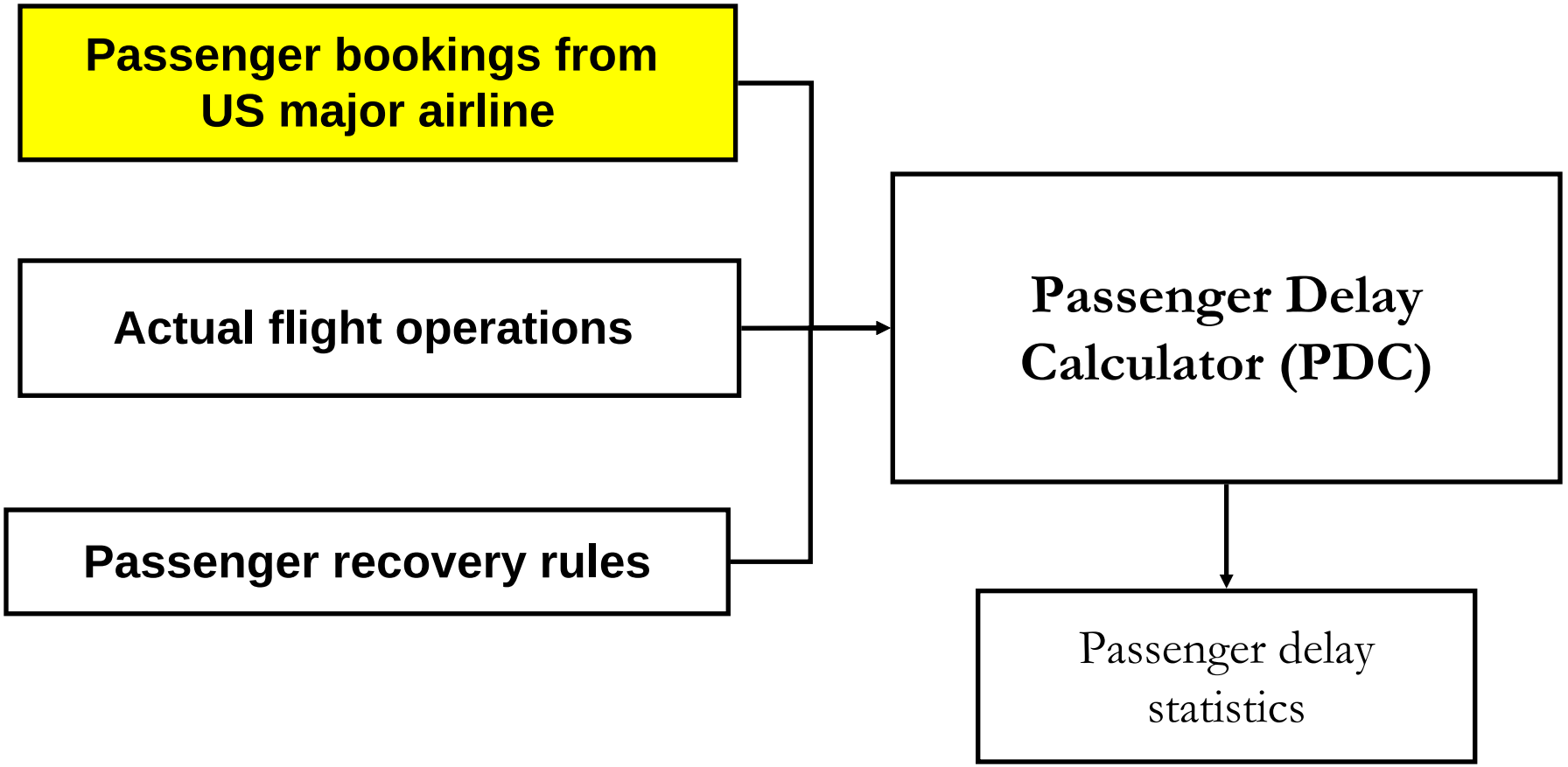
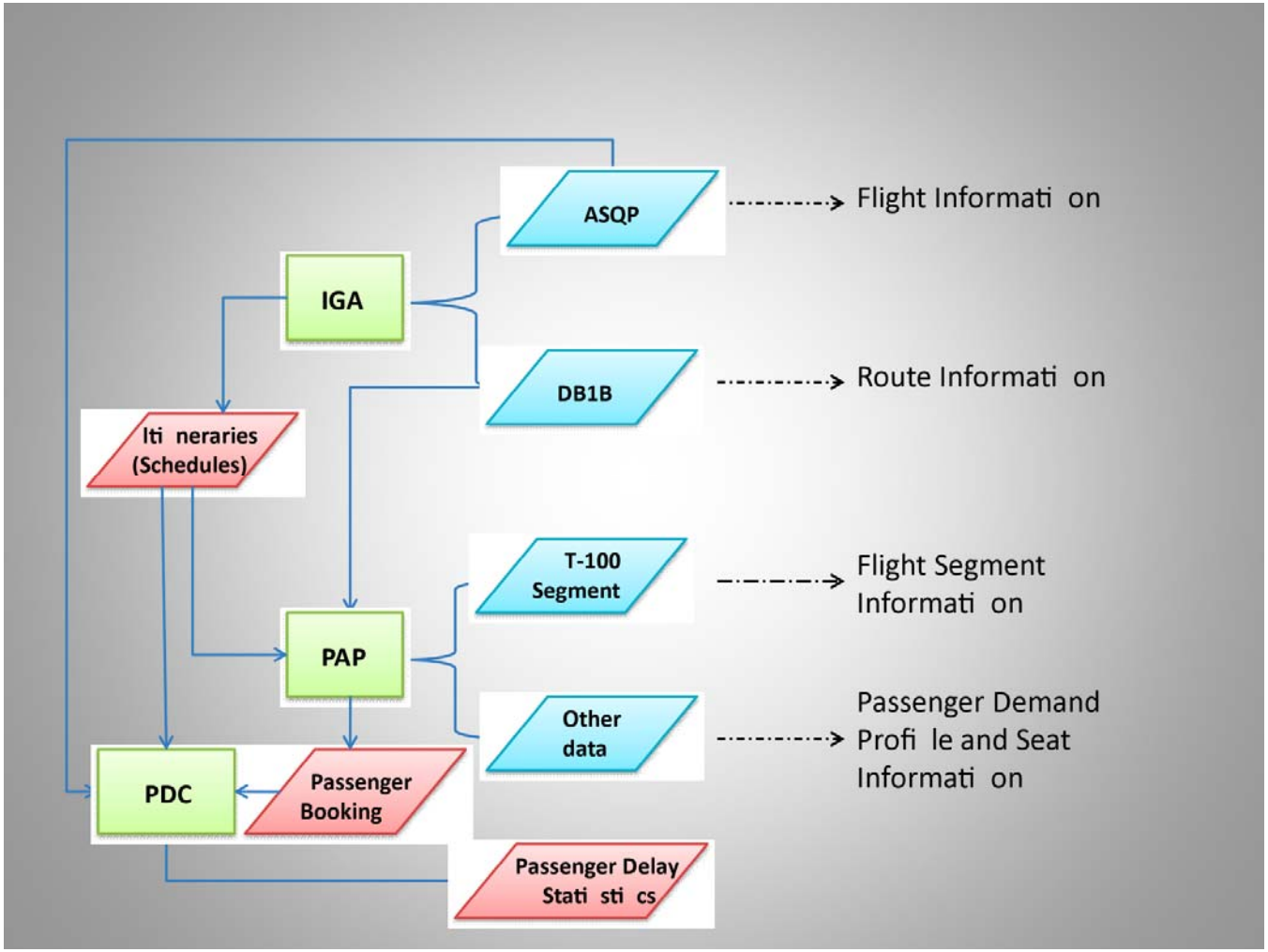


Passenger Bookings Generator and Passenger Delay Calculator



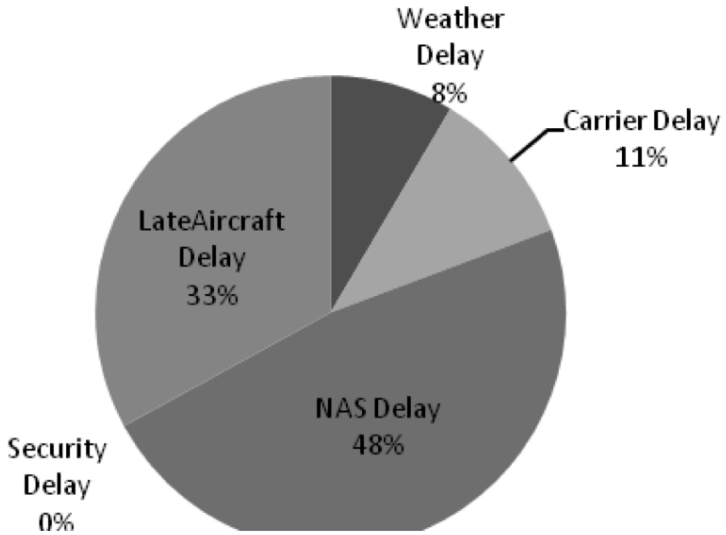
Observations from the Case Study
(Passenger delays and disruptions)

	Airline A (07/08/2006)	Airline B (07/08/2006)	Airline A (07/12/2006)	Airline B (07/12/2006)
3. Average load factor per flight leg	79.20%	81.20%	78.00%	74.30%
Average Flight Delay (F-Delay)				
4. 15 minutes on time performance (*15-OTP*)	87.60%	89.00%	60.60%	75.80%
5. Percentage of delayed flights* (only flights operated)	12.40%	11.00%	39.40%	24.20%
6. Percentage of cancelled flights	0	0.44%	1.52%	0.89%
7. Average delay of operated flights (minutes)	6.36	4.82	38.75	12.28
Average Passenger Delay (P-Delay)				
9. Average delay of all passengers (minutes)	8.11	8.74	53.84	21.28
11. Percentage of *disrupted* passengers	0.40%	0.44%	2.80%	1.25%
12. Average delay of *non-disrupted* passengers (minutes)	7.31	5.03	41.48	14.23
14. Average delay of *disrupted* passengers (minutes)	261.76	409.39	482.99	578.25
Ratio of P-Delay to F-Delay				
9 to 7	1.28	1.81	1.38	1.73
12 to 7	1.15	1.04	1.07	1.16
14 to 7	41.16	84.94	12.46	47.09

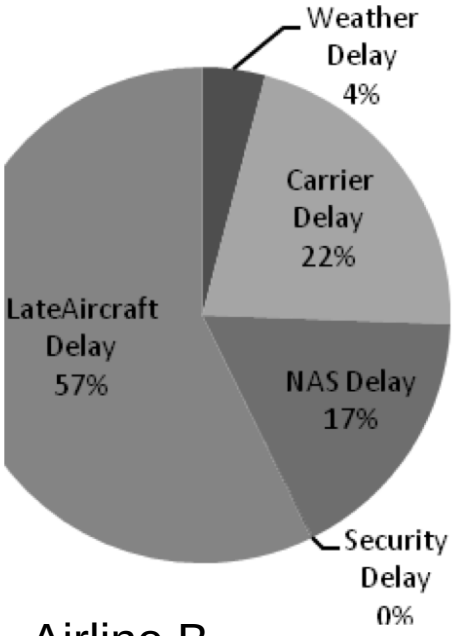
Airline A is disproportionately impacted by weather, for both passengers and aircraft

Causes of Delay

Are disproportionate impact of delays for Airline A relative to Airline B due to 'aggressive' scheduling practices, or differences in weather and NAS impacts?



Airline A



Airline B

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Higher ratio of passenger to flight delay for B than for A

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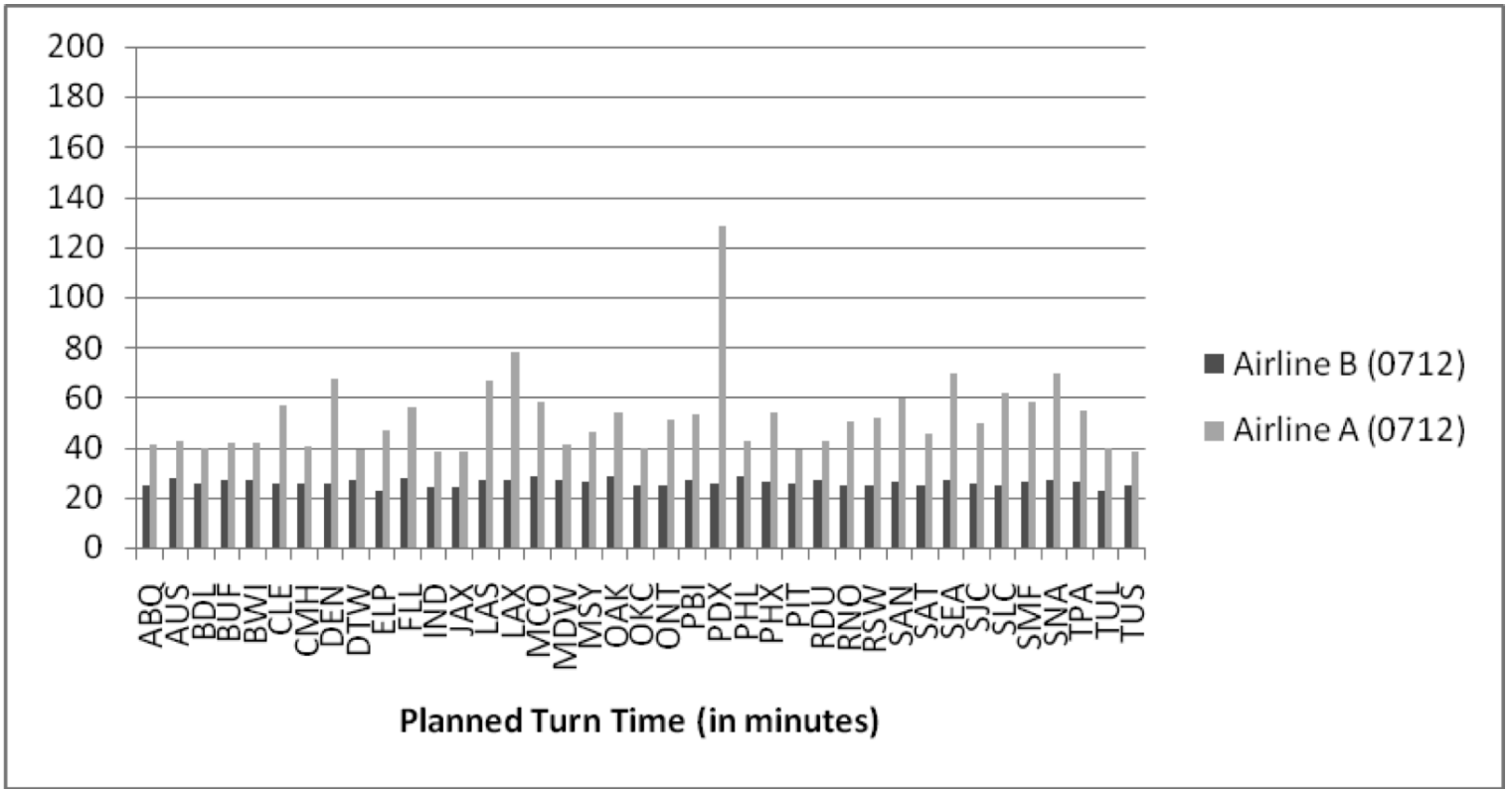
Higher ratio of disrupted passenger delay to flight delay for B than for A

Aircraft delays underestimate passenger delays… but the size of the error is airline dependent

What accounts for these airline-specific differences?

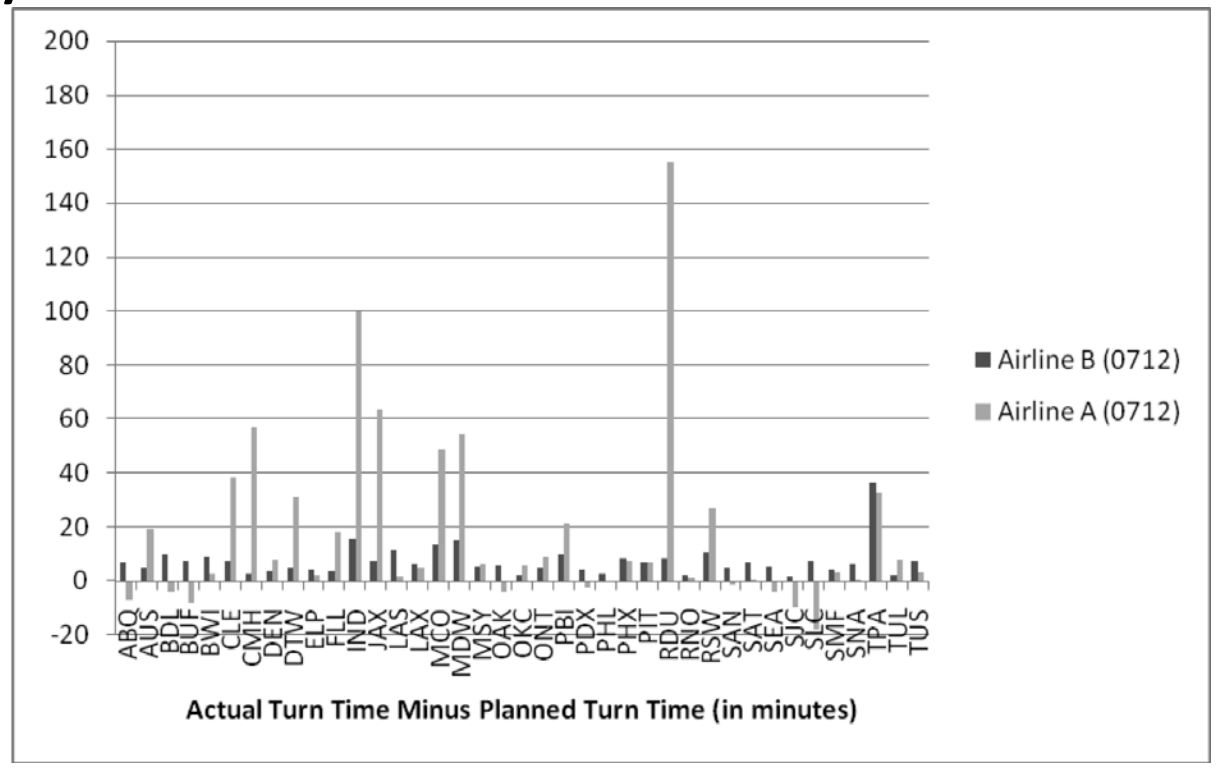
Turn Time Observations

- A: Banked network- ground time slack
- B: Quick turns, little to no ground time slack



Turn Time Observations

- A: Excess ground time slack not sufficient
- B: Little to no ground time slack but limited delays



Block Time Observations

- A: Sometimes insufficient block time slack
- B: Adequate block time slack

Origin	Dest	PBLK (Airline B) hours\minutes	ABLK (Airline B) hours\minutes	ABLKS (Airline B) hours\minutes	PBLK (Airline A) hours\minutes	ABLK (Airline A) hours\minutes	ABLKS (Airline A) hours\minutes
BWI	CLE	1:10	1:07	3	1:20	1:35	-15
CLE	BWI	1:10	1:05	5	1:26	1:22	4
CLE	LAS	4:20	4:19	1	4:22	4:15	7
CLE	PHX	4:15	3:53	22	4:09	4:09	0
LAS	CLE	4:05	3:46	19	3:56	4:13	-17
PHX	CLE	3:50	3:35	15	3:49	3:44	5

Propagated Delay Observations

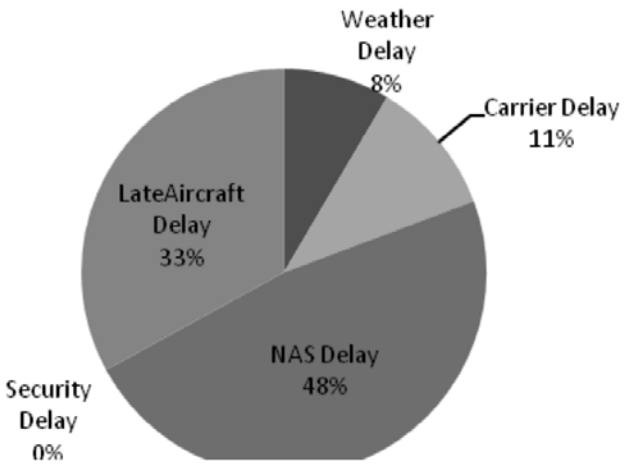
- Arrival delay propagates for a higher percentage of flights in Airline B's network than in Airline A's network
  - Airline B has little to no turn time slack
  - Block time slack for Airline B curbs propagation and improves on-time performance
- Although a greater percentage of flights experience delay propagation in Airline B, its passengers are not impacted as greatly as Airline A passengers
  - Average propagated delay less for Airline B than Airline A
  - Average passenger connection time for B is 135 minutes compared to 98 minutes for

AVERAGE	PD (minutes)	IDD (minutes)	IAD (minutes)	Total Number of Flights	Number of Flights with PD	Percent of Flights with PD
Airline A (07/08/06)	1.58	5.1	3.48	727	25	3.4%
Airline A (07/12/06)	12.48	20.65	25.43	922	121	13%
Airline B (07/08/06)	2	4.74	1.83	2686	188	7%
Airline B (07/12/06)	6.19	7.27	4.63	3116	580	18.7%

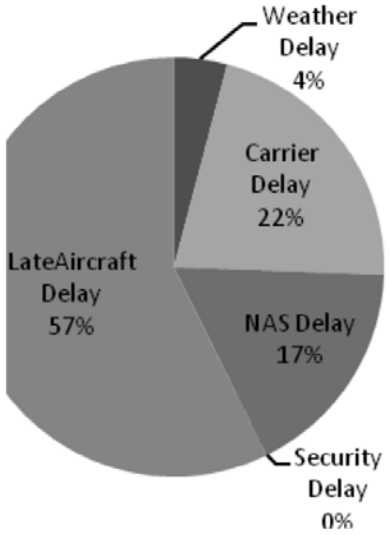
- Scheduling turn times with little to no slack and adding slack into block times is an effective strategy for ‘getting back on schedule’ for Airline B
- Airline A schedules slack in turn times and ‘smaller amounts’ of slack in block times with less success in ‘getting back on schedule’, particularly for bad weather days

Should Airline A adopt the scheduling strategy of Airline B?

Independent Delay Observations



Airline A



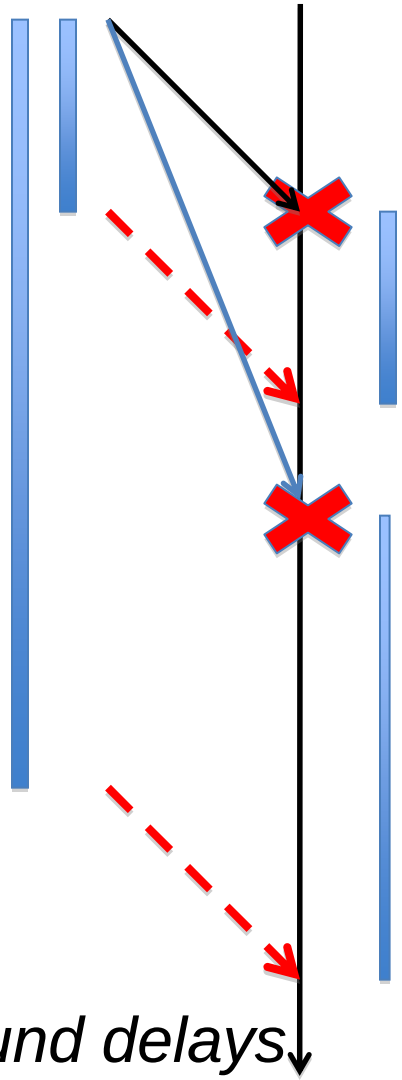
Airline B

July 12, 2006	IDD	IAD	PD
Hub average (Airline A)	13.77	17.98	6.62
"Hub" average (Airline B)	5.21	6.02	7.33
Ratio (Airline A/Airline B)	2.64	2.99	0.90

- Independent delays far greater for Airline A than Airline B on bad weather days

Independent Delay Observations

For Airline A, for flights subject to ground delays, added block time slack results in INCREASED delay-- ration-by-schedule slot allocation results in INCREASING levels of delays for flights scheduled later in the ground delay program



While block time slack is effective for Airline B, it will not reduce delays for Airline A flights subjected to ground delays

Key Findings

Aircraft delays are not good estimators of passenger delays

Relative airline on-time-performance is not a reliable indicator of relative passenger delay

Effective strategies for achieving schedule reliability and on-time-performance differ by airline-- *important factors: airport congestion, NAS delays, weather, aircraft turn times and passenger connection times, hubs (banked or not)*

Many opportunities for designing new approaches to find reliable, robust flight networks for passengers and aircraft

Next Research Steps

- Conduct comprehensive analysis of passenger and flight delays
  - Quantifying the impact of NAS delays, scheduling practices, hub banking structures, etc. on relationship between aircraft and passenger delays
  - Vaze building on work of Bratu, Ying
- Develop schedule optimization techniques to select robust ground and block times
  - Chiraphadhanakul building on work of Lan, Marla
- Evaluate various slot allocation schemes during GDPs to assess impacts on airline delays, passenger delays and 'fairness'; and evaluate impacts of slot exchanges in reducing delays
  - Fearing building on work of Harsha

QUESTIONS/ COMMENTS ?