*Office of Inspector General*

# *Audit Report*

## AIR CARRIER FLIGHT DELAYS AND CANCELLATIONS

***Federal Aviation Administration***
***Bureau of Transportation Statistics***
***Office of the Secretary of Transportation***

***Report Number: CR-2000-112***
***Date Issued: July 25, 2000***

# Memorandum

U.S. Department of Transportation
Office of the Secretary of Transportation
Office of Inspector General

Subject: ACTION: Audit of Air Carrier Flight Delays and Cancellations
CR-2000-112

Date: July 25, 2000

From: Alexis M. Stefani
Assistant Inspector General for Auditing

Reply to
Attn of: JA-50

To: Federal Aviation Administrator
Director, Bureau of Transportation Statistics
Assistant General Counsel for Aviation Enforcement and Proceedings

This is our final report on the Audit of Air Carrier Flight Delays and Cancellations. The objective of this audit was to examine the causes of flight delays and cancellations. Due to the high complexity of this issue and the large differences in the systems used for tracking delays, cancellations, and associated causes, we focused the audit on determining the strengths and weaknesses of the various systems as well as the overall amount of delay occurring in the National Airspace System. Specifically, we examined the systems used by the Department of Transportation's (DOT) Bureau of Transportation Statistics (BTS) and Federal Aviation Administration (FAA).

This report describes the increase in delays and cancellations and presents data on the length and nature of delays. It also reports on the lack of uniform methods for tracking delays and the various actions underway to improve the systems for tracking and reporting flight delays.

However, a major finding of our work, and one on which urgent attention is required, is the absence of a system for collecting causal data and reporting a reasonably complete picture of the causes of delays and cancellations. The need for good causal data was recently reinforced by Congress in The Wendell H. Ford Aviation Investment and Reform Act for the 21st Century. This Act directs the Secretary of Transportation to modify existing regulations governing the air carrier data submissions to DOT ". . . to disclose more fully to the public the nature and source of delays and cancellations experienced by air travelers." Until consistent causal data are available, examination of the causes of delays and identifying effective long term solutions will be problematic.

While actions have been initiated to strengthen the reporting system, much work remains to be done if delays and cancellations are to be addressed in a meaningful way. This reports makes recommendations to develop a common system for tracking delays, cancellations, and associated causes, as well as to provide consumers with better information on delays and cancellations such as a system-wide measure of increases in travel time and routes with high cancellation rates.

We met with senior officials from FAA, BTS, and DOT's Office of Aviation Enforcement and Proceedings, as well as the Air Transport Association to discuss our draft report findings and recommendations. As appropriate, we have incorporated their comments into the final report. FAA officials cited their progress with the air carriers in developing a common system for tracking delays and cancellations, as well as deploying new traffic management tools. Likewise, BTS officials noted plans to include additional delay-related information on their website. Overall, DOT officials agreed with the recommendations and cited initiated or planned actions aimed at improving the tracking systems used to collect and report on flight delays, cancellations, and associated causes.

In accordance with DOT Order 8000.1C, we would appreciate receiving your written comments within 30 days. Please indicate for each recommendation the specific action taken or planned and the target dates for completion. If you do not concur with a specific recommendation, please provide your rationale. Furthermore, you may provide an alternative course of action that you believe would resolve the issues.

We appreciate the courtesies and cooperation of DOT representatives during this audit. If you have any questions concerning this report, please call me at (202) 366-1992, or Mark Dayton, Acting Deputy Assistant Inspector General for Competition Oversight, Economic, Rail, and Special Programs, at (202) 366-9970.

Attachment

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# EXECUTIVE SUMMARY

## *AUDIT OF AIR CARRIER FLIGHT DELAYS AND CANCELLATIONS*

***FEDERAL AVIATION ADMINISTRATION***
***OFFICE OF THE SECRETARY OF TRANSPORTATION***
***BUREAU OF TRANSPORTATION STATISTICS***

**REPORT NO. CR-2000-112** **JULY 25, 2000**

## OBJECTIVE

The Chairman of the Senate Subcommittee on Transportation and Related Agencies, Committee on Appropriations, asked us to examine the sources and causes of flight delays and cancellations. Due to the high complexity of this issue and the large differences in the systems used for tracking delays, cancellations, and associated causes, we focused the audit on determining the strengths and weaknesses of the various systems as well as the overall amount of delay occurring in the National Airspace System. Specifically, we examined the systems used by the Department of Transportation's (DOT) Bureau of Transportation Statistics (BTS) and Federal Aviation Administration (FAA).[1]

While BTS, FAA, and air carrier systems provide information on the quantity of delays, information on the causes of delays was found to be incomplete and inconsistent. The need for causal data was recently reinforced by Congress in The Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR-21). This Act directs the Secretary of Transportation to modify existing regulations governing air carrier data submissions to DOT ". . . to disclose more fully to the public the nature and source of delays and cancellations experienced by air travelers." Until complete and consistent data are available, however, examination of the causes of delays and identifying viable solutions (i.e., changes in air carrier scheduling practices and FAA's air traffic control), will be problematic. It is critical, therefore, that DOT implement the requirements of AIR-21 without delay. We will continue to monitor the Department's actions to implement an improved reporting system. See Exhibit A for a full discussion of the audit scope and methodology.

[1] In a complementary effort, the OIG is auditing the airlines' customer service plans, as required by The Wendell H. Ford Aviation Investment and Reform Act for the 21st Century. The OIG's Interim Report on Airline Customer Service Commitment (AV-2000-102) was issued on June 27, 2000, with a final report due by December 31, 2000.

## BACKGROUND

FAA estimates that delays to commercial aviation cost the airlines over $3 billion a year and projects that delays throughout the system will continue to increase as the demand for passenger travel rises. Moreover, passengers are directly affected by the inconvenience of delays in terms of missed flight connections, missed business meetings, and loss of their personal time. Over the last year, the news media reported a growing debate on flight delays and their causes. One large U.S. airline claimed that it lost as much as $120 million in the first half of 1999 because of air traffic control (ATC) delays and canceled flights. In contrast, FAA contended that few delays resulted from ATC equipment problems, with the bulk of all delays attributable to poor weather.

Title 14, Code of Federal Regulations, Chapter II, Part 234.4, Reporting on On-Time Performance, requires domestic air carriers that account for at least one percent of domestic scheduled passenger revenues to submit monthly Airline Service Quality Performance Reports (or ASQP data) to BTS' Office of Airline Information. The 10 reporting air carriers are: Alaska Airlines, America West Airlines, American Airlines, Continental Airlines, Delta Air Lines, Northwest Airlines, Southwest Airlines, Trans World Airlines, United Airlines, and U.S. Airways. BTS and DOT's Office of Aviation Enforcement and Proceedings, in turn, use the data to generate information that is provided to consumers through the Internet *(www.bts.gov/ntda/oai)* or the monthly Air Travel Consumer Report. The latter report, also available on the internet *(www.dot.gov/airconsumer)*, includes information on the percentage of flights departing and arriving on time by airport, as well as the percentage of mishandled baggage, the percentage of passengers denied boarding on oversold flights, and the number of consumer complaints by airline.

In this monthly report, a flight is counted as "on time" if it departed or arrived within 15 minutes of scheduled gate departure and arrival times[2] shown in the airline's reservation system. Using this definition, an aircraft could wait an hour or more on the airport runway for takeoff and be reported as having departed on time if it left the gate within 15 minutes of its scheduled departure. An arriving aircraft could land at an airport ahead of scheduled arrival and be reported as late if it did not reach the gate within the 15 minute grace period after scheduled arrival.

FAA also collects data on flight delays via the Operations Network (OPSNET). OPSNET data come from observations by FAA personnel who manually record aircraft that were delayed for 15 minutes or more after coming under FAA's

[2] According to DOT guidance, gate departure occurs when the aircraft parking brake is released. Likewise, gate arrival occurs when the parking brake is set.

control, i.e., the pilot's request to taxi out.[3] As such, an aircraft could wait an hour or more at the gate or ramp area before requesting clearance to taxi. So long as the flight, once under FAA's control, took off within 15 minutes of the airport's standard taxi-out time, the flight would be considered an on-time departure.[4] OPSNET reported delays (e.g., departure, en route, arrival, and traffic management initiative[5]) are categorized by five general causes: (1) weather, (2) ATC or airport equipment problems, (3) closed runway/taxiway, (4) terminal/center volume, and (5) other. Delays attributable to an air carrier's operations, such as aircraft and flight crew problems, are not included in OPSNET, nor are canceled flights (regardless of the cause).

A key reason for differing data maintained by FAA and BTS is in how each uses the information it collects. For FAA, delay information serves to measure system-wide ATC performance as well as to identify areas for improvement. For BTS, measuring delays (and subsequent ranking of air carriers by on-time arrival performance) serves as a source of air travel information to consumers and helps ensure more accurate reporting of flight schedules by the air carriers. Because of these differences, however, the data reported by FAA and BTS can cause confusion for policy makers and the general public when one organization records a flight as on time and another organization records it as delayed.

## RESULTS IN BRIEF

### *Flight Delays Increased From 11 to 58 Percent*

Both BTS and FAA reported increases in all types[6] of flight delays between 1995 and 1999.[7] For instance, according to BTS data, delays increased 11 percent (1,863,265 to 2,076,443) during this time period. Likewise, FAA data identified an even larger increase of 58 percent (236,802 to 374,116). Figure 1 illustrates FAA-reported delays from 1995 to 1999. Moreover, the rate of flight delays to total flight operations also increased. For example, using OPSNET data, the

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3 One exception is FAA-ordered ground delays and stops, which are counted in OPSNET data even though they may occur before the aircraft has left the gate.

4 For example, using 10 minutes as the standard taxi-out time for an airport, an aircraft taking 30 minutes between the pilot's request for clearance to taxi and takeoff would incur a 20-minute departure delay under OPSNET.

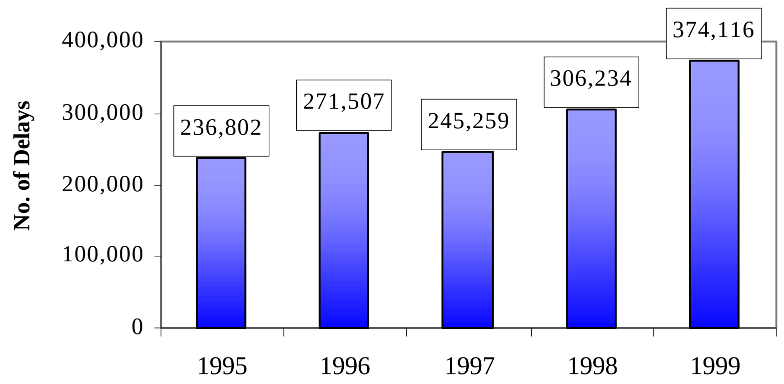
5 Traffic management initiative (TMI) delays are those enacted by or coordinated through the Air Traffic Control System Command Center at Herndon, Virginia. They generally occur on the ground prior to wheels off in the form of ground delays or ground stops.

6 BTS' totals included gate departure and arrival delays, while FAA's totals included departure, en route, arrival, and TMI delays.

7 All data results are based on calendar years, not fiscal years.

average rate for the 28 major airports went from 1.7 to 2.3 percent between 1995 and 1999. We also found that the number of delays continued to increase in 2000. Overall, there were about 12 percent more FAA-reported delays and over 5 percent more BTS-reported delays during the first 5 months of 2000 than during the same period in 1999. As discussed in this report, a key reason for the large differences between BTS and FAA delay totals is the differing systems used by these agencies in defining and tracking flight delays, with BTS tracking only the gate departure (but not taxi-out, en route, and taxi-in) and arrival points of a flight and FAA the intervening ground and airborne phases.

**Figure 1: Growth in FAA-Reported Flight Delays**




### *Length of Delays Also Increased, Ranging From 16 to 18 Percent*

Not only were there more delays in 1999, but those occurring were also longer. Table 1 lists the average duration of FAA OPSNET delays (i.e., departure, en route, arrival, and TMI) and BTS arrival delays from 1995 to 1999.[8] Overall, the length of FAA OPSNET delays increased 16 percent, while BTS arrival delays increased 18 percent.

**Table 1: Duration of FAA OPSNET and BTS Arrival Delays**

| Year | FAA OPSNET Delays (in minutes) | BTS Arrival Delays (in minutes) |
|---|---|---|
| 1995 | 37:34 | 42:41 |
| 1996 | 40:41 | 46:12 |
| 1997 | 37:45 | 44:40 |
| 1998 | 41:04 | 49:19 |
| 1999 | 43:30 | 50:26 |
| % Change 1995-99 | 16% | 18% |

### *Most Delays Occur on the Ground During Departure, With Taxi-Out Delays of 1 Hour or Greater Increasing by 130 Percent*

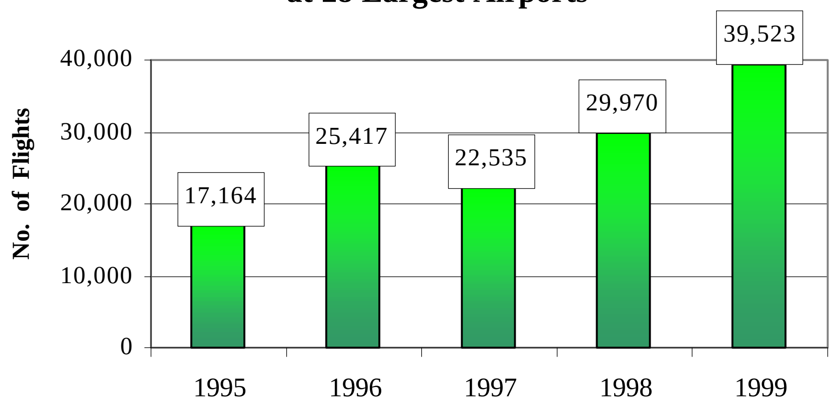
We found that most delays took place on the ground—although the actual cause of the delay may occur elsewhere in the system (e.g., poor weather). FAA's analysis

8 These averages are based on delays of 15 minutes or more, since 15 minutes is the cut-off point used by both BTS and FAA in determining a delay.

of flights to and from 55 major U.S. airports found that ground delays represented approximately 83 percent of the total delay time in 1999. This percentage is supported by our own analysis of BTS data.[9] Specifically, we determined that 82 percent of the increase in gate-to-gate[10] times between 1995 and 1999 was due to longer taxi-out and taxi-in times, with the remaining 18 percent involving longer en route times. This represents a noticeable shift from 1996, when only 60 percent of the increase in gate-to-gate times (over 1995) was due to longer ground times.

We also found that the number of taxi-out times of 1 hour or more (i.e., flights in which the aircraft has departed the gate but remained for extended periods of time

**Figure 2: Taxi-Out Times of 1 Hour or More at 28 Largest Airports**




on the ground awaiting takeoff) had increased 130 percent, as noted by Figure 2. Of even greater concern for passengers is the number of flights with taxi-out times of 2, 3, and 4 hours, which increased at an even faster pace, i.e., 186, 216, and 251 percent, respectively, between 1995 and 1999.

### *Actual Extent of Delays Is Much Greater, and Is Masked By Increases in Scheduled Flight Times*

To compensate for longer ground and air times, the air carriers have increased their flight schedules on nearly 82 percent (1,660 of 2,036) of domestic routes between 1988 and 1999, ranging from 1 to 27 minutes. Overall, we identified 390 domestic routes, comprising 793,586 flights in 1999,[11] which experienced

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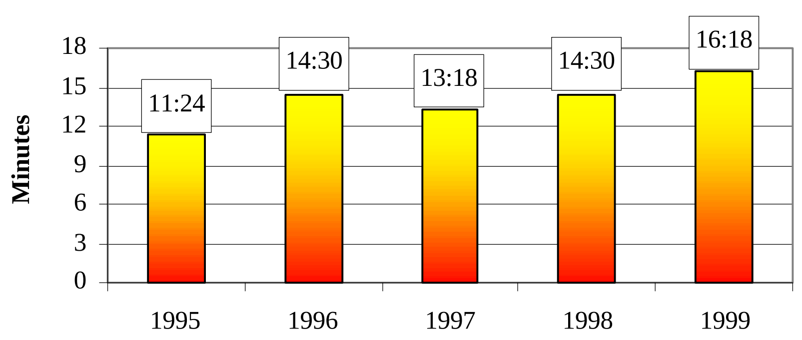
9 All calculations involving scheduled and actual gate-to-gate times, were based on weighted averages of routes flown by the 10 major air carriers during 1995 to 1999 or 1988 to 1999.

10 Also referred to as "block" time, gate-to-gate time covers the period between gate departure and gate arrival.

11 These flights represented nearly 15 percent of the 10 air carriers' completed flight operations in 1999.

schedule increases of approximately 10 to 27 minutes (on average) over the last 11 years.[12] Three examples include Ontario, California to Minneapolis, Minnesota (27 minutes); Ft. Lauderdale, Florida to Boston, Massachusetts (23 minutes); and Newark, New Jersey to Los Angeles, California (21 minutes).[13] By increasing their scheduled flight times, however, the actual growth in travel time throughout the system—as tracked by BTS—is underreported. For example, the number of arrival delays reported to BTS would have been nearly 25 percent higher in 1999 if flight schedules had remained at their 1988 levels. Overall, we calculate that scheduled delays added nearly 130 million minutes of travel time for air passengers from 1988 through 1999.

**Figure 3: Consumer Flight Delay Indicator 1995-99 (Base Year 1988)**




In an effort to measure the actual growth in travel time, taking into account *both scheduled and unscheduled delays,* we developed the *Consumer Flight Delay Indicator (CFDI).* This indicator calculates the average delay time per flight flown by the 10 major air carriers. Using 1988 as the base year, we found that the CFDI rate in 1999 was 16 minutes 18 seconds.[14] This represents a 42 percent increase from 1995, when the CFDI was 11 minutes and 24 seconds, as indicated by Figure 3. We are recommending that the Department use the CFDI or a comparable measure to more accurately portray system-wide increases or decreases in passenger travel time.

## *Cancellations Increased by 68 Percent*

As indicated by Figure 4, the number of canceled flights the 10 major air carriers reported to BTS increased 68 percent, from 91,905 to 154,311, between 1995 and 1999.[15] Increases have continued this year, with the first 5 months of 2000

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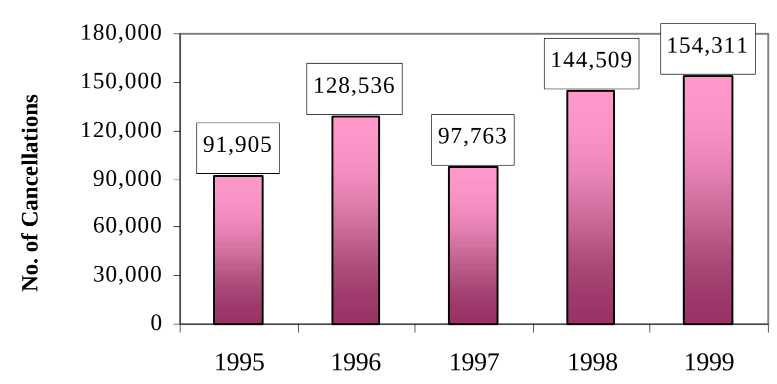
[12] To measure the full growth in flight times, we went back to 1988, the first complete year of ASQP data from the 10 major air carriers.

[13] We found similar increases in the actual gate-to-gate times for many of these routes. See Chapter 1 for a listing of the 10 routes with the largest increases between 1988 and 1999.

[14] We calculated that 10 of 28 major U.S. airports had CFDIs equal to or greater than 20 minutes in 1999.

[15] Of the 144,509 cancellations in 1998 (see Figure 4), 29,439 or 20 percent were due to strike-related activities at Northwest Airlines.

**Figure 4: Growth in Cancellations (BTS Data)**




experiencing over 5 percent more cancellations than the same period in 1999. We also found that the rate of cancellations to total flights increased from 1.7 to 2.8 percent during this time period.[16] Some high-traffic routes have cancellation rates three to five times higher than the national average in 1999 including Newark to O'Hare (14.4 percent), San Francisco to Los Angeles (11.5 percent), and Washington, DC to Boston (9.6 percent). (See Chapter 1 for a full discussion of the increases in delays and cancellations.)

## *DOT Lacks Uniform Methodology for Tracking Delays*

We found major differences in the methodologies used by FAA and BTS to determine flight delays. As a consequence, FAA and BTS differ as to what they consider a delay and how such delays are calculated. For example, FAA tracks OPSNET delays on the taxiway and runway (departure) and airborne (en route and arrival). BTS tracks delays at the departure and arrival gates. As a consequence, the differing methodologies can lead to somewhat confusing (if not misleading) results.

For instance, FAA calculates a delayed departure as the difference between the time a pilot requests FAA clearance to taxi and the time an aircraft's wheels lift off the runway, minus the airport's standard unimpeded taxi-out time.[17] Under this methodology, a flight could sit at the gate or ramp area for several hours before requesting clearance to taxi. So long as the flight, once under FAA's

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16 For the first 5 months of 2000, the cancellation rate was 3.3 percent.

17 According to FAA, unimpeded taxi-out time is the taxi-out time under optimal operating conditions, when neither congestion, weather, nor other factors delay the aircraft during its movement from gate to takeoff. Unimpeded taxi-out time varies by airport, depending on the airport layout.

control, took off within 15 minutes of the airport's standard taxi-out time, FAA would consider the flight an on-time departure, as illustrated by our first example.

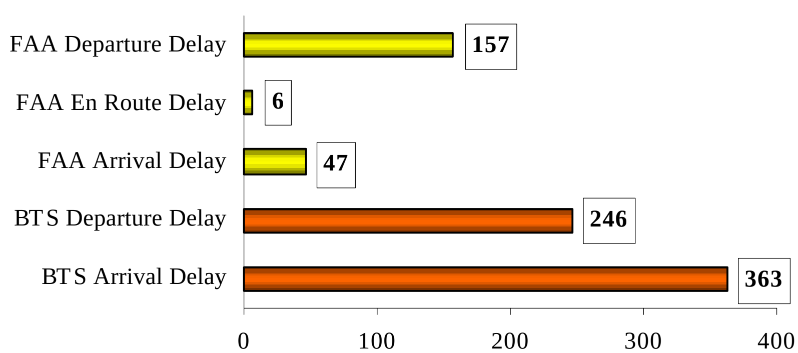
In comparison, BTS calculates a delayed departure as the difference between scheduled and actual departure from the gate. Under this methodology, a flight could sit several hours in the ramp area or on the runway and BTS would still consider it an on-time departure, as long as it left the gate within 15 minutes of the scheduled departure time, as illustrated by our second example.

***EXAMPLE 1***: On November 2, 1999, United Airlines flight 645 from Newark to O'Hare left the gate 68 minutes late due to mechanical problems. Because this delay took place at the gate, it incurred a departure delay as defined by BTS. Once repaired, however, the flight took off within 24 minutes of receiving FAA's clearance to taxi. Because the total time period between the request for taxi and wheels off did not exceed the allotted taxi-out time of 29 minutes at Newark, FAA did not record a departure delay.

***EXAMPLE 2***: On November 1, 1999, American Airlines flight 1599 from Newark to O'Hare departed the gate at the scheduled time. As such, it achieved an on-time departure as defined by BTS. Because of an FAA ground delay, the aircraft remained in the ramp/taxiway an additional 113 minutes before takeoff. FAA, therefore, recorded a departure delay since the elapsed period far exceeded Newark's allotted taxi-out time of 29 minutes.

The differing methodologies have resulted in large variances in the number and type of flight delays reported. For example, BTS reported over five times as many delays as FAA in 1999 (2,076,443 versus 374,116). Likewise, our sample of 1,690 flights also identified large differences. As Figure 5 notes, we tracked 609 gate departure and arrival delays using BTS criteria versus 210 departure,[18] en route, and arrival delays using FAA criteria, for an overall difference of 399 delays.

**Figure 5: OIG Sample of 1,690 Flights**
**(November 1 through 5, 1999)**

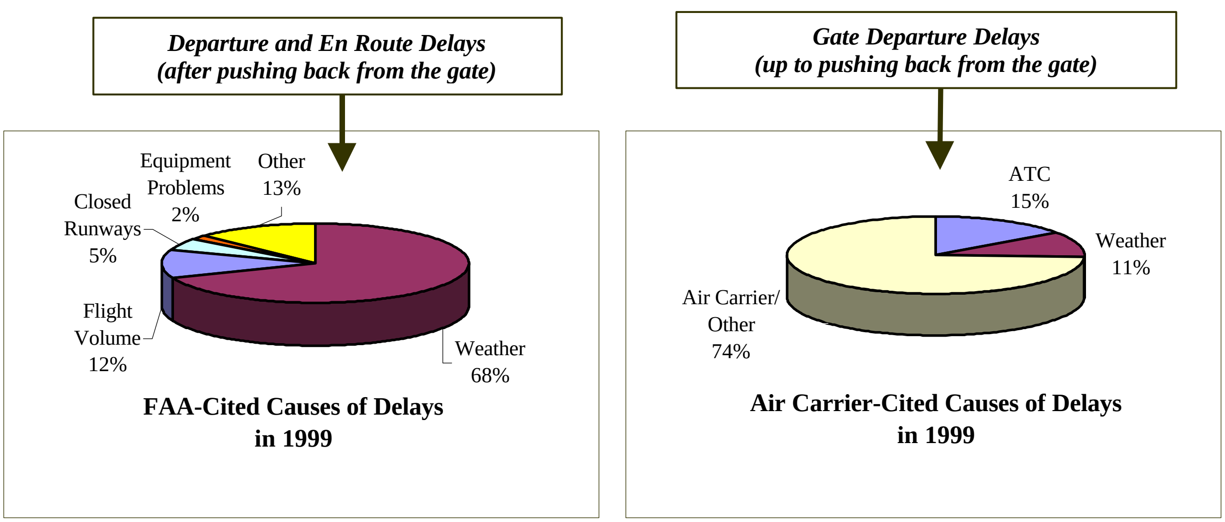



[18] Included in this departure delay category were TMI delays.

### *Significant Lack of Agreement and Incomplete Data Fuel Controversy Over Causes of Delays*

We found significant disagreement within the aviation community as to the causes of flight delays and cancellations. The Air Transport Association, for example, blames FAA and weather for most delays. In contrast, FAA points to weather and flight volume as the main factors. The lack of consistent and complete causal data has only fueled this debate, with no one system possessing a full picture of the causes of flight delays and cancellations. For example, BTS does not collect causal data for delays or cancellations. FAA only collects causal data on delays reported through OPSNET, but maintains no comparable information on cancellations. Moreover, FAA causal codes do not cover delays due to air carrier activities, such as aircraft maintenance, lack of aircraft or flight crew, boarding of passengers, or fueling. While most of the air carriers maintain causal information for internal purposes on both delays and cancellations, those causes are associated primarily with gate departure delays (up to the aircraft pushing away from the gate), and generally are not consistent with the causal information collected by FAA. Figure 6 highlights the large differences between FAA and air carrier causal data for flight delays.[19]

**Figure 6: FAA- and Air Carrier-Cited Causes for Delays in 1999**




As Figure 6 shows, the air carriers attributed 74 percent of *gate departure delays* to such factors as: (1) scheduled and unscheduled aircraft maintenance, (2) ground services (e.g., aircraft fueling, baggage, and catering), (3) customer service issues, and (4) late arriving aircraft and/or crew in which the underlying cause for tardiness (e.g., weather, ATC, and dispatch) is not clearly identified. The air carriers pointed to ATC (15 percent) and weather (11 percent) as causing

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[19] Causal data were obtained from 8 of the 10 largest air carriers for gate departure delays of 15 minutes or more.

the remaining amount of gate departure delays. The air carriers also attributed 54 percent of the cancellations in 1999 to air carrier/other factors, followed by weather (32 percent) and ATC (14 percent).

Once the aircraft left the gate and came under ATC control, FAA OPSNET data identified weather as causing 68 percent of the departure and en route delays in 1999, followed by flight volume (12 percent), closed runways (5 percent), ATC and airport equipment problems (2 percent), and other[20] (13 percent). FAA-imposed ground delays and stops, which can impact flights both at the gate and during the taxi-out phase, is the only area where both FAA and the air carriers record causal data—although such data will frequently differ (e.g., FAA citing weather and the air carriers citing ATC). In addition, if the aircraft pushes away from the gate prior to FAA imposing a ground delay or stop, then only FAA would record any causal data. During the taxi-in phase (after the aircraft has landed), we found that neither FAA nor the air carriers maintained causal data, even though taxi-in delays represent approximately 8 percent of total delay time in 1999.[21]

The lack of consistent, uniform causal data—covering all flight phases—has led to substantial disagreements over the sources of delays. Whereas FAA cites weather as a major cause, the air carriers question the agency's management of air traffic during poor weather conditions. Likewise, the air carriers point to outdated ATC equipment and inefficient air traffic management practices, while FAA cites new equipment installation, increasing flight volume, and limited system capacity. Without good causal data, it is unlikely that the current debate within the aviation community will end, nor the increasing number of flight delays and cancellations. It is critical, therefore, that FAA and the air carriers work together in developing a common set of categories for reporting causal information on flight delays and cancellations—as called for by The Wendell H. Ford Aviation Investment and Reform Act for the 21st Century. Chapter 2 presents information on the various databases and associated problems in tracking delays and cancellations and their causes.

### *FAA and Air Carriers Point to Similar Causes for the Increase in Delays in 1999*

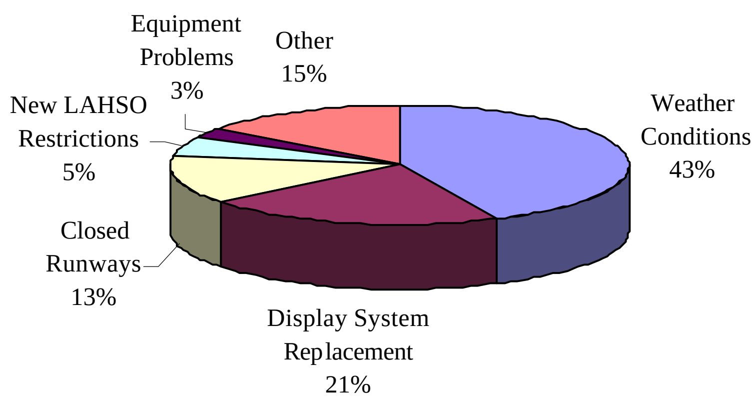
When looking at the *causes for the increasing number of delays in 1999*, as compared to 1998, there was some agreement between FAA and the air carriers. For example, both FAA and the air carriers identified weather as causing about

[20] For FAA, the other category includes emergency conditions or other special nonrecurring activities, such as an air show, VIP movement, or radio interference. International delays are also included in this category.

[21] Percentage breakout of taxi-in delays was derived from FAA's Consolidated Operations and Delay Analysis System (CODAS).

43 percent of the increase. The air carriers attributed the remaining 57 percent to FAA's ATC. In comparison, OPSNET data identified various causes, including the installation of Display System Replacement monitors (new ATC equipment) at FAA's en route centers, closed runways, new Land and Hold Short Operations (LAHSO)[22] restrictions, ATC and airport equipment problems, and various other factors (see Figure 7).

**Figure 7: Sources of Increases in FAA-Cited Delays in 1999**




Beyond the causal data provided by FAA and the air carriers, we found that most delays and cancellations occur once capacity at an airport or in the airspace is exceeded (demand) and/or reduced (supply). Notwithstanding poor weather, we identified five salient factors causing flight delays. The first three factors relate to excess demand, including the growth in flight volume, air carrier scheduling practices, and increased use of regional jets. In comparison, the last two factors relate to reduced supply, including new LAHSO restrictions and FAA equipment and traffic management practices. See Chapter 3 for a discussion of these factors.

## *Although Various Actions Are Underway, Much Work Remains*

Over the past year, FAA has made some progress in improving how the agency tracks and reports flight delays and cancellations. It has not made similar progress with respect to obtaining good causal data.

[22] LAHSO is an ATC procedure that permits the issuance of landing clearances to aircraft to land and hold short of an intersecting runway, taxiway, or other designated point on the runway. It is a procedure designed to increase airport capacity and to more efficiently move aircraft within the terminal airspace and on the airport surface.

Partly in response to the increase in delays and cancellations as well as the number of complaints,[23] FAA along with representatives of the airline industry conducted an extensive evaluation in 1999 aimed at improving its management of air traffic. As a result of the evaluation, FAA and the industry identified 165 near-term action items to relieve delays, including: (1) limiting locally initiated ground stops to 30 minutes; (2) providing estimates to air carriers of the time a ground stop will end and the cause for this action; and (3) ensuring that local facilities coordinate miles-in-trail restrictions[24] through the David J. Hurley National Air Traffic Control System Command Center. According to FAA, most of the action items have been implemented.

FAA's evaluation also spurred a number of other initiatives. For example, FAA is deploying several traffic management tools, including: the Flight Schedule Monitor, Collaborative Convective Forecast Product, and Departure Spacing Program. FAA has also established a web site (www.fly.faa.gov) that provides consumers real-time information on air carrier delays at the Nation's 40 largest airports. The web site is also linked to other information sources, such as the status of the National Airspace System, which shows all the ground delays and stops the FAA has currently enacted across the Nation.

FAA also recognizes the need for a common system for tracking delays, cancellations, and their causes. As a result, the agency has been working closely with the major air carriers in developing the Aviation System Performance Metric (ASPM). ASPM, which became operational in April 2000, establishes a uniform set of metrics by which to measure delays during each flight segment, i.e., gate departure, taxi-out, en route, taxi-in, gate arrival, and overall flight time. ASPM also provides FAA and the participating air carriers with next day reports via the Internet of delays occurring at 21 airports, on routes and flights, and within the overall system. FAA officials noted that ASPM will initially be used to help identify and track delays and cancellations as well as measure ATC performance. They also noted their intent to eventually include causal information in ASPM, which will be critical in helping FAA and the air carriers identify areas for improvement, such as changes in traffic management practices, funding for equipment and airport enhancements, and airspace redesign.

*Notwithstanding these efforts, much work remains to be done—especially in the area of causal data—if delays and cancellations are to be addressed in a*

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[23] For example, of those consumer complaints received by DOT, the number relating to flight delays increased 528 percent between 1998 and 1999. At the same time, all aviation-related complaints received by DOT increased 113 percent.

[24] Miles-in-trail is an ATC tool that intentionally paces traffic by increasing spacing between aircraft to keep volume at manageable levels. This spacing between aircraft should not be confused with the FAA safety separation standards requirement of 5 nautical miles laterally or 2,000 feet in altitude, in sectors of high-altitude traffic.

*meaningful way.* A good starting point is the development of a uniform system through which all components of DOT and the air carriers will be able to track flight delays and cancellations as well as measure ATC performance. In addition to this system, the aviation community needs to reach agreement on a common set of causal categories, as required by AIR-21. Once established, these categories will serve as a basis for obtaining complete and consistent information on the various causes of flight delays and cancellations, not just those currently recorded by FAA or the air carriers. What is feasible in the way of delay relief, short and long term, can only be addressed with a common language between the air carriers and FAA and an agreed-upon system for tracking the proximate and underlying causes of delays and cancellations from pre-gate departure through all stages of a flight. Finally, the Department needs to reassess the information it provides consumers, especially in the area of departure delays. The current emphasis on gate departure and arrival delays does not reflect the full extent of delays, much of which is occurring on the ground in the form of longer taxi-out times or is being underreported due to expanded flight schedules.

## RECOMMENDATIONS

We recommend that:

1. FAA, in coordination with BTS, DOT's Office of Aviation Enforcement and Proceedings, and air carriers, continue development of a common system for tracking delays, cancellations, and associated causes, such as improving ASPM.

2. FAA ensure future performance plans include one or more measures for assessing ATC performance that are based on ASPM (not OPSNET) data.

3. BTS, in coordination with FAA and DOT's Office of Aviation Enforcement and Proceedings, provide consumers the following information on a monthly basis: (a) major causes of delays and cancellations by airport, (b) routes with high cancellation rates by air carrier, and (c) an improved measure for tracking ground times once the aircraft has departed the gate.[25]

4. BTS, in coordination with FAA and DOT's Office of Aviation Enforcement and Proceedings, report on a quarterly basis the CFDI or a comparable measure to more accurately portray system-wide increases or decreases in travel time.

[25] Some possible options for measuring ground times include: (a) average taxi-out times during peak and non-peak hours of operation by airport, and (b) the rate of significant taxi-out times of 1 hour or greater by air carrier and airport. These alternative measures would be more helpful to consumers than reporting (per existing regulation) an aircraft departure as occurring on time simply because it backed away from the gate as scheduled only to sit on the runway for several hours.

## MANAGEMENT AND OIG COMMENTS

OIG representatives met with senior officials from FAA, BTS, and DOT's Office of Aviation Enforcement and Proceedings, as well as the Air Transport Association to discuss our draft report findings and recommendations. As appropriate, we have incorporated their comments into the final report. FAA officials cited their progress with the air carriers in developing a common system for tracking delays and cancellations, as well as deploying new traffic management tools (e.g., Flight Schedule Monitor and Departure Spacing Program). They also noted their intent to move away from OPSNET as a basis for measuring future ATC performance. Likewise, BTS officials noted plans to include additional delay-related information on their website. Overall, DOT officials agreed with the recommendations and have initiated and/or have planned actions aimed at improving the tracking systems used to collect and report on flight delays, cancellations, and associated causes. We agree with these actions and see them as being responsive to our recommendations.

# TABLE OF CONTENTS

# CHAPTER 1: GROWTH IN FLIGHT DELAYS AND CANCELLATIONS

Delays and cancellations have increased significantly over the last few years. This chapter begins with an overview of flight delays, including the number, rate, and duration, as well as where and when they occurred. Next, we address the growth in air carrier flight schedules, which has led to an underreporting of many delays. To measure the true extent of delays in the system, taking into account changes in flight schedules, we present the Consumer Flight Delay Indicator (CFDI). Finally, we discuss the number and rate of cancellations, as well as the overall cost of both delays and cancellations for the 10 major air carriers.

## *Number and Rate of Flight Delays Reported Increased Significantly Between 1995 and 1999*

Between 1995 and 1999, both the Bureau of Transportation Statistics (BTS) and the Federal Aviation Administration (FAA) reported increases in all types[1] of delays. As Figures 1 and 2 illustrate, BTS delays[2] increased from 1,863,265 to 2,076,443 (or 11 percent) during this time period. Likewise, FAA-reported Operations Network (OPSNET)[3] delays increased from 236,802 to 374,116

**Figure 1: BTS-Reported Flight Delays, 1995-99**

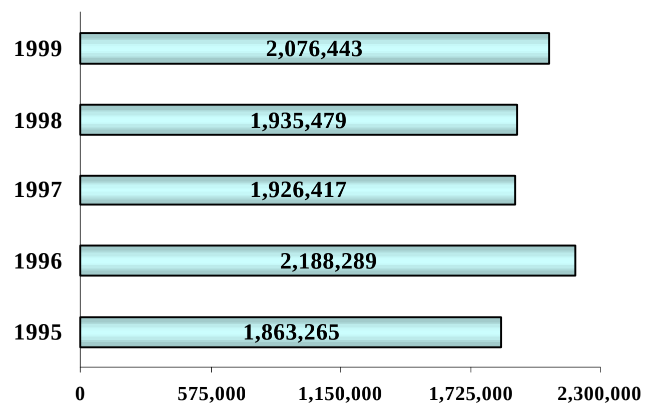
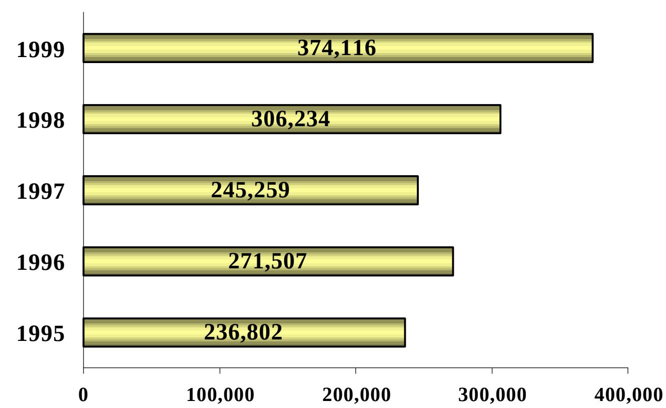



**Figure 2: FAA-Reported Flight Delays, 1995-99**




1 Delay types include: (a) gate departure and arrival (BTS) and (b) departure, en route, and arrival (FAA).

2 BTS delay data were derived from Airline Service Quality Performance Reports (or ASQP). Examples of ASQP data include: air carrier, flight number, origin and destination airport, scheduled and actual gate departure times, wheels off and on times, and scheduled and actual gate arrival times.

3 OPSNET data come from observations by FAA personnel who manually record aircraft that were delayed for more than 15 minutes after coming under FAA's control, i.e., after a pilot's request to taxi.

(or 58 percent). One noticeable exception, however, is that BTS reported more delays in 1996 than in 1999.[4] We also found that the number delays continue to increase in 2000. Overall, there were approximately 12 percent more FAA-reported delays and over 5 percent more BTS-reported delays during the first 5 months of 2000 than during the same period in 1999. (See Exhibits D and E for a listing of FAA- and BTS-reported delays for the 28 major airports.)

Whereas FAA reported a 58 percent increase in OPSNET delays between 1995 and 1999, results among the 28 major airports varied.[5] Overall, 18 airports reported increases in delays, whereas 10 reported decreases. Figures 3 and 4 list the five airports with the largest increases and decreases in OPSNET delays between 1995 and 1999. (See Chapter 3 for a brief discussion of these 10 airports and the main reasons for the increase or decrease in OPSNET delays.)[6]

**Figure 3: Five Airports with Largest Increases in OPSNET Delays, 1995-99**

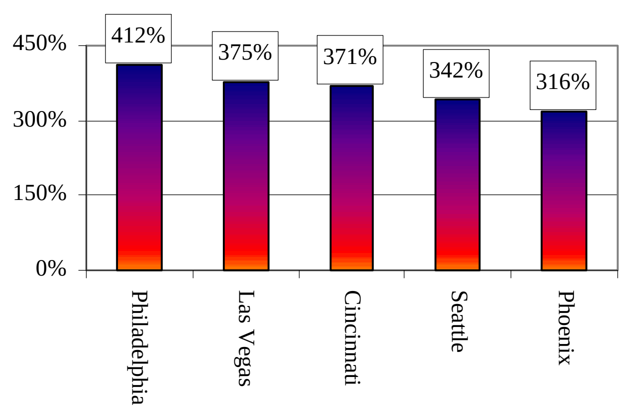
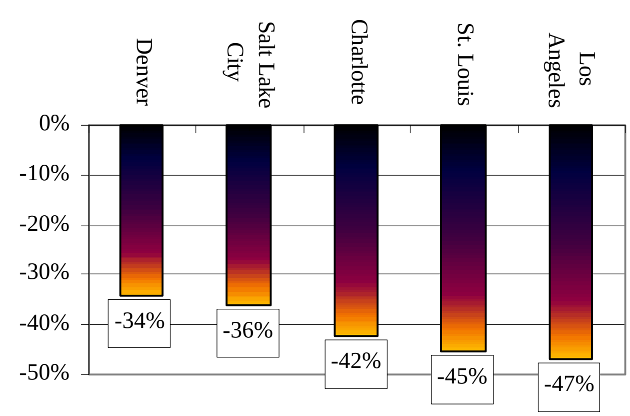



**Figure 4: Five Airports with Largest Decreases in OPSNET Delays, 1995-99**




We also found that the rate of flight delays to total flight operations also increased. For example, using OPSNET data, we found that the average rate for the 28 major airports went from 1.65 to 2.34 percent between 1995 and 1999. We also found

4 We identified several possible explanations for the high number of delays in 1996. The first involves the added time inserted by the air carriers in their flight schedules. As discussed in Chapter 2, we found that 1996 had the highest number of delayed flights and the least amount of excess schedule time of any year since 1995. A second explanation is weather, which was especially bad during the winter of 1996. A final explanation is cited in FAA's National Plan of Integrated Airport Systems (NPIAS) 1998-2002. The NPIAS notes that delays rose in 1996 "apparently due to the introduction of new separation standards which increased the distance between certain types of aircraft."

5 Overall, 50 percent of all FAA-reported delays in 1999 occurred at six airports (Atlanta, Dallas/Ft. Worth, LaGuardia, Newark, O'Hare, and San Francisco), with the remaining amount divided between the other major airports (37 percent) and several hundred smaller airports (13 percent).

6 According to FAA, Philadelphia was particularly hard hit by a rapid increase in flight operations, coupled with runway and terminal construction at the airport. The combination of these events led to the significant increase in both delays and cancellations in 1999.

that many of the 28 airports had individual rates significantly higher than the average for 1999, including: Newark (7.9 percent), LaGuardia (7.7 percent), O'Hare (5.5 percent), San Francisco (4.8 percent), and Kennedy (3.8 percent).

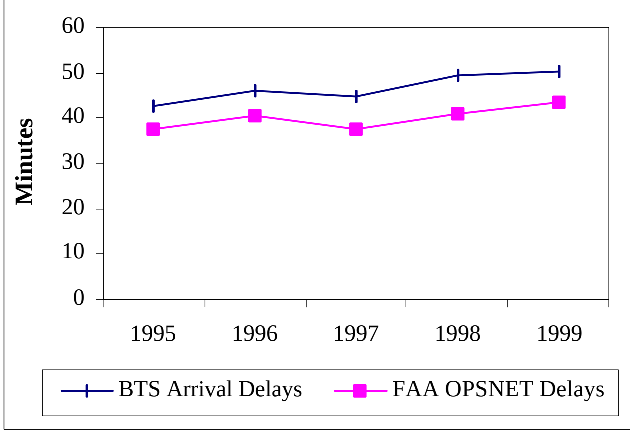
### *Flight Delays Are Also Getting Longer*

Not only were there more delays in 1999, but those occurring were also longer. Table 1 lists the average duration of OPSNET and BTS delays from 1995 to 1999. Overall, the length of OPSNET delays increased 16 percent, while BTS arrival delays increased 18 percent.[7] Even though each measures very different aspects of delays,[8] when compared across the 5 years, we found comparable trend lines between the two data sets, as illustrated by Figure 5.

**Table 1: Duration of OPSNET and BTS Arrival Delays**

| Year | OPSNET Delays (in minutes) | BTS Arrival Delays (in minutes) |
|---|---|---|
| 1995 | 37:34 | 42:41 |
| 1996 | 40:41 | 46:12 |
| 1997 | 37:45 | 44:40 |
| 1998 | 41:04 | 49:19 |
| 1999 | 43:30 | 50:26 |
| % Change 1995-1999 | 16% | 18% |

**Figure 5: Average Duration of Flight Delays, 1995-99**




Although the average duration of OPSNET delays was about 43 minutes in 1999, we found substantial differences among the 28 airports, with times ranging from 70 minutes at Baltimore to 25 minutes at Las Vegas. Figure 6 lists the five airports with the longest average duration of OPSNET delays in 1999. Length of delay, however, must be viewed in the context of the total number of delays. For instance, the average duration of delays at Baltimore and Newark were approximately 70 and 50 minutes, respectively. Yet, Baltimore experienced less than 1/20th the number of OPSNET delays as did Newark (1,573 vs. 36,524) in 1999. (See Exhibit D for average duration of OPSNET delays for the 28 airports.)

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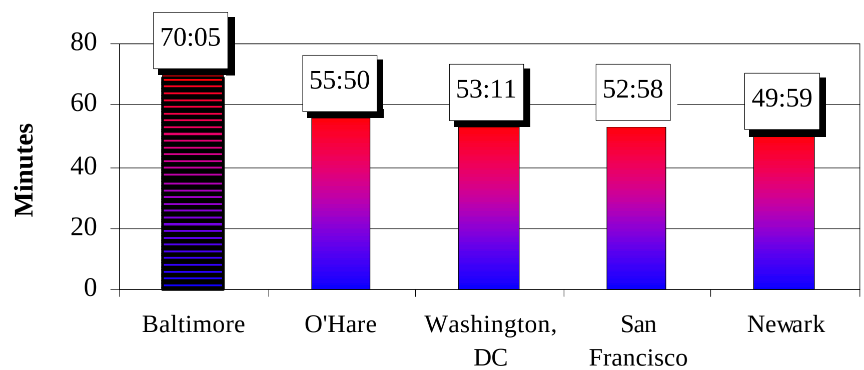
7 Both calculations were based on an average of all flights delayed 15 minutes or more.

8 For example, FAA's data incorporate several types of delays, including those incurred on the ground and in the air, whereas BTS data pertain only to gate arrival.

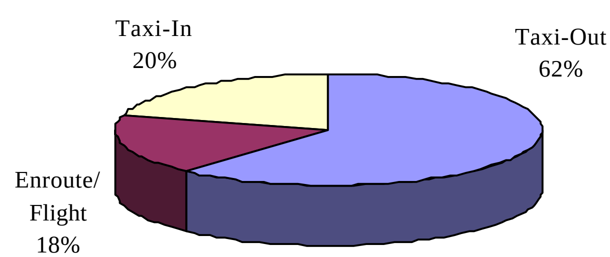
**Figure 6: Five Airports with Longest Average Duration of OPSNET Delays in 1999**




We also found that the average duration of delays increased even at those airports that experienced a decline in the number of OPSNET delays between 1995 and 1999. For example, the number of reported delays at Salt Lake City decreased by 36 percent (1,125 to 718), while the average duration of the delays increased 92 percent (25:22 to 48:42 minutes). Likewise, Denver's delays dropped 34 percent (1,901 to 1,254), while the length of delays increased 41 percent (30:37 to 43:14 minutes).

### *Most Delays Occur on the Ground*

**Figure 7: Source of Increases in Gate-to-Gate Times, 1995-99**




We found that most delays took place on the ground. For example, FAA's analysis of flights to and from 55 major U.S. airports found that ground delays (i.e., gate departures, taxi-out, and taxi-in) represented about 83 percent of total delay time in 1999.[9] This percentage is supported by our analysis of BTS data. We found that 82 percent of the increase in gate-to-gate[10] times between 1995 and 1999 was due to longer taxi-out and taxi-in times, with the remaining 18 percent involving longer flight times (see Figure 7).[11] This represents a

9 Specifically, flight delays in 1999—as measured by FAA—occurred in the following areas: gate departure (48 percent), taxi-out and taxi-in (35 percent), and en route (17 percent).

10 Also referred to as "block" time, gate-to-gate time covers the period between gate departure and gate arrival.

11 All calculations involving scheduled and actual gate-to-gate times, were based on weighted averages of routes flown by the 10 major air carriers during 1995 to 1999 or 1988 to 1999.

noticeable shift from 1996, when only 60 percent of the increase from 1995 in average gate-to-gate times was due to longer ground times. (Exhibit F lists the changes in flight schedules by taxi-out, flight, and taxi-in times for flights departing the 28 major airports, 1995 to 1999.)

Also based on our analysis of BTS data, we found that the number of taxi-out times of 1 hour or more (e.g., flights in which the aircraft has departed the gate but remained for extended periods of time on the ground awaiting takeoff) increased from 17,164 to 39,523 (or 130 percent), between 1995 and 1999. Moreover, as noted in Table 2, the number of flights with taxi-out times of 2, 3, and 4 hours increased at even a faster pace (i.e., 186, 216, and 251 percent, respectively) during this time period.[12] In contrast, flights with *taxi-in* times of 1 hour or more increased by about 35 percent between 1995 and 1999, but extended taxi-in times were far less frequent than extended taxi-out times.

**Table 2: Number of Flights with Taxi-out Times of 1 to 5+ Hours, 1995-99 (BTS Data)**

| Time Period | 1995 | 1999 | % Change 1995-99 |
|---|---|---|---|
| 1-2 Hrs. | 15,071 | 33,469 | 122% |
| 2-3 Hrs. | 1,686 | 4,821 | 186% |
| 3-4 Hrs. | 307 | 969 | 216% |
| 4-5 Hrs. | 67 | 235 | 251% |
| >5 Hrs. | 33 | 29 | -12% |
| Total: | 17,164 | 39,523 | 130% |

FAA and air carrier officials cited several reasons for these long delays, including air carrier gate-hold procedures and FAA ground stops.[13] With gate-holds, a pilot may elect to stay at the gate when a known problem (poor weather conditions, ground delay program in effect, etc.) makes take-off unlikely in the short term. However, the aircraft may be forced to depart to provide gate space for an incoming aircraft. Under a ground stop, a pilot might elect to remain on the runway to ensure the aircraft's position in the departure queue once FAA ends the ground stop.

Figure 8 lists the five airports[14] with the highest percentage of flights with significant taxi-out times (1 hour or more) as compared to total commercial flight

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[12] These are conservative figures, since these data only pertain to flights departing the 28 major airports, and do not include delayed flights that were eventually canceled. As happened at the Detroit Airport on January 2-3, 1999, once they departed the gate, numerous flights became stranded due to heavy snowfall and had to be canceled. Yet, passengers on many of these flights were left on the aircraft from 1 to 9 hours before being allowed to deplane.

[13] A ground stop is an ATC tool used to manage the flow of air traffic to an airport impacted by such factors as adverse weather, closed runways, or excess flight volume. With a ground stop, aircraft are ordered to stop until such time as the situation that caused the stoppage is resolved.

[14] Newark, Kennedy, and LaGuardia are frequently at the top of many of the rankings in this report. As will be discussed in Chapter 3, one reason for this is the growing airspace congestion in and around the New York City area.

operations. Likewise, Table 3 provides the percentages for each of the 10 major air carriers, which ranged between 2.51 and 0.03 percent. (See Exhibit G for the number of significant taxi-out times for the 10 major air carriers and 28 airports, 1995 versus 1999.)

**Figure 8: Five Airports with the Highest Percentage of Flights with Taxi-Out Times of 1 Hour or More in 1999**

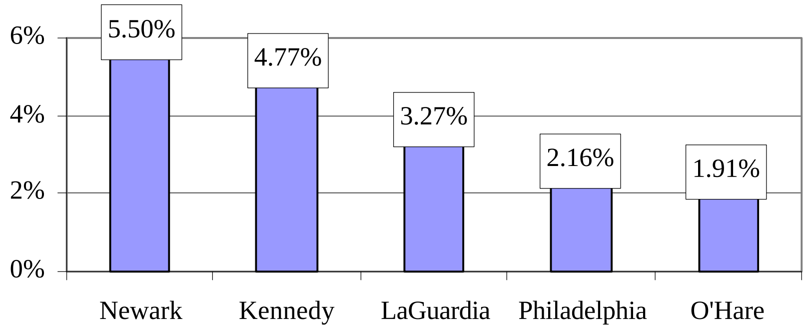



**Table 3: Percent of Taxi-out Times 1 Hr. or More by Air Carrier, 1999 (BTS Data)**

| Air Carrier | Percentage |
|---|---|
| Continental | 2.51% |
| American | 1.73% |
| Northwest | 1.28% |
| United | 1.09% |
| Trans World | 1.07% |
| Delta | 0.98% |
| US Airways | 0.94% |
| America West | 0.41% |
| Southwest | 0.11% |
| Alaska | 0.03% |
| Average | 1.13% |

When comparing the three largest airports (as ranked by total flight operations), we found noticeable differences in the number and rate of significant taxi-out times. As Table 4 indicates, Atlanta had less than half the number of significant taxi-out times than O'Hare (2,445 versus 5,385). In addition, Atlanta had 2 flights with taxi-out times of 4 hours or more, whereas Dallas/Ft. Worth and O'Hare had 43 and 57, respectively. In explaining Atlanta's relative success, FAA and air carrier officials pointed to their close working relationship in Atlanta, which allowed for the quick dissemination of information relating to FAA-imposed ground stops to carrier personnel. According to Delta officials, the timely receipt of such information and their preference for holding aircraft at the gate as opposed to on the taxiway was a key reason for the lower number of significant taxi-out times. FAA officials also noted that flight operations at Atlanta were less affected by poor weather than at Dallas/Ft. Worth and O'Hare.

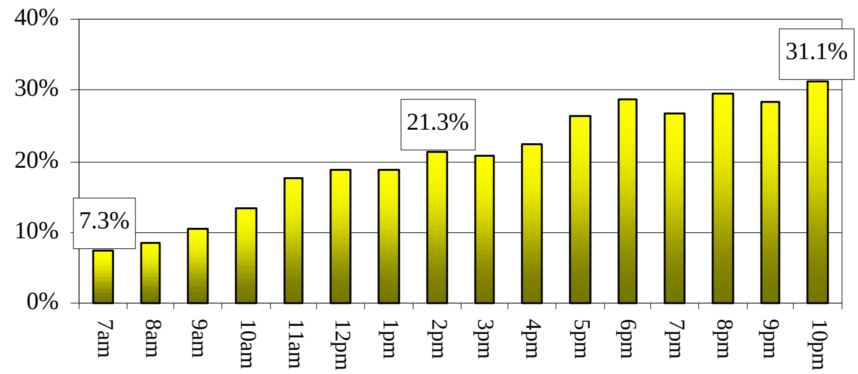
**Table 4: Flights with Taxi-Out Times of 1 Hour or More at Atlanta, Dallas/Ft. Worth, and O'Hare Airports, 1999 (BTS Data)**

| Airport | 1-2 hrs. | 2-3 hrs. | 3-4 hrs. | 4-5 hrs. | > 5 hrs. | Total | % of Total Operations |
|---|---|---|---|---|---|---|---|
| Atlanta | 2,204 | 221 | 18 | 2 | 0 | 2,445 | 0.95% |
| Dallas/Ft. Worth | 2,643 | 489 | 71 | 41 | 2 | 3,246 | 1.36% |
| O'Hare | 4,154 | 969 | 205 | 55 | 2 | 5,385 | 1.91% |

## *Delays More Likely in Evening and During Peak Periods of Airport Operation*

We also examined delays by hourly increments (using BTS data from the 10 air carriers). Overall, we found that the rate of late arrivals increased significantly as the day progressed. As Figure 9 indicates, the average rate at the 28 major airports in 1999 increased from a low of 7.3 percent at 7 a.m. to a high of

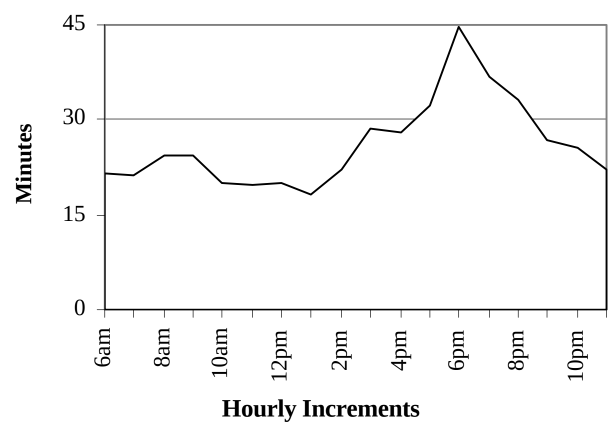
**Figure 9: 28 Airports' Percent of Delayed Arrivals by Time of Day, 1999**




31.1 percent by 10 p.m.[15] According to FAA and air carrier officials, such increases are due to the build up of delays in the system, which tend to peak during the evening hours.

We also found that taxi-out times[16] varied greatly depending on the time of day and number of scheduled flight operations at the 28 airports, especially those airports in the Northeast.[17] As illustrated by Figure 10, Kennedy's average taxi-out time in 1999 varied from a low of 18 minutes in the early afternoon to a high of 44 minutes in the evening. Closely tracking these times were the airport's domestic flight operations (arrivals and departures),

**Figure 10: Kennedy's Taxi-Out Times in 1999**



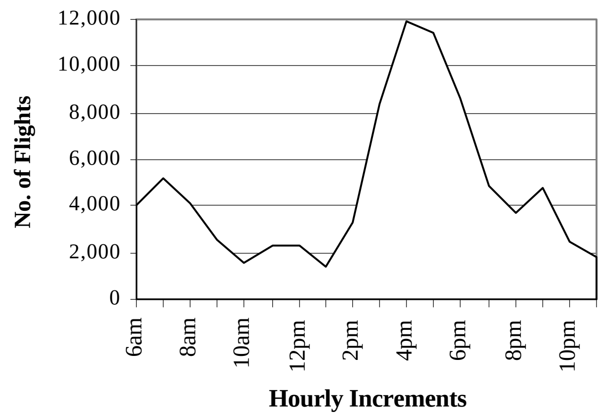

15 For this analysis, late arrivals also included canceled and diverted flights.

16 Whereas taxi-in times also varied by time of day, the hourly ranges were much smaller than with taxi-out times.

17 Other than in the Northeast, most major airports saw smaller differences in their hourly taxi-out times. For instance, the hourly taxi-out times for Los Angeles ranged between 12 and 20 minutes, a difference of only 8 minutes.

which also peaked in the early evening, as indicated by Figure 11. A passenger flying out of Kennedy, therefore, could save 26 minutes, on average, in travel time by selecting an early afternoon flight.

**Figure 11: Scheduled Departures and Arrivals at Kennedy, 1999**




### *Air Carriers Have Expanded Schedules to Account for Growing Delays*

As a result of longer ground and air times, actual gate-to-gate time increased on 77 percent (1,571 of 2,036) of domestic routes[18] flown between 1988 and 1999, ranging from 1 to 22 minutes. Of those routes with increasing times, we identified 219, comprising 521,473 flights in 1999, for which actual gate-to-gate times had increased 10 minutes or more, on average, over the last 11 years. Table 5 lists the 10 routes with the largest increases in actual gate-to-gate times between 1988 and 1999.[19]

**Table 5: Routes with Largest Increases in Actual Gate-to-Gate Times, 1988-99**

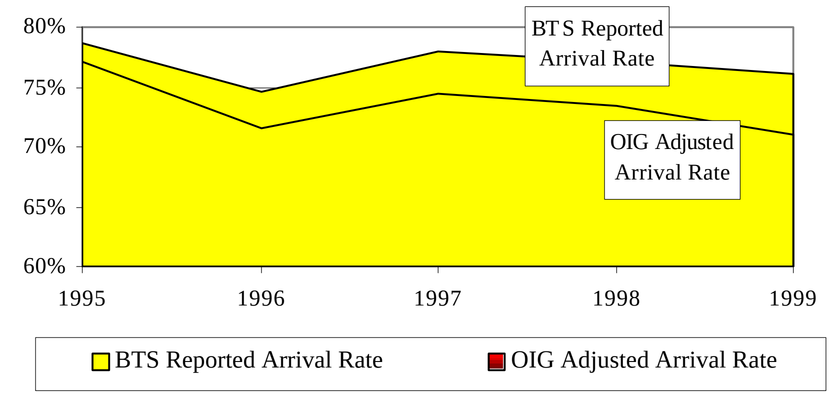
| No. | Departure Airport | Arrival Airport | Increase (minutes) |
|---|---|---|---|
| 1 | Kennedy, NY | Seattle, WA | +22:48 |
| 2 | Newark, NJ | Los Angeles, CA | +22:21 |
| 3 | Phoenix, AZ | Dulles, VA | +21:26 |
| 4 | Phoenix, AZ | Atlanta, GA | +19:43 |
| 5 | Ft. Lauderdale, FL | Boston, MA | +19:40 |
| 6 | Kennedy, NY | Salt Lake City, UT | +19:34 |
| 7 | Las Vegas, NV | Baltimore, MD | +19:02 |
| 8 | Phoenix, AZ | Philadelphia, PA | +18:50 |
| 9 | Boston, MA | Fort Lauderdale, FL | +18:25 |
| 10 | Portland, OR | Anchorage, AK | +17:38 |

18 Includes only those domestic routes with 500 or more flights in 1999. This analysis does not account for changes in fleet composition (e.g., type of aircraft), which may have resulted in faster or slower air speeds.

19 Cross-country routes represented a large portion of those routes with increased gate-to-gate time between 1988 and 1999.

To compensate for rising gate-to-gate times, the air carriers have increased their flight schedules nearly 5 minutes, on average, between 1988 and 1999.[20] Such increases reduced the number of arrival delays reported to BTS, which would have been nearly 25 percent higher in 1999 if flight schedules had remained at their 1988 levels. They also helped maintain the air carriers' on-time arrival statistics (published in DOT's monthly air travel consumer report), which otherwise would have dropped over 5 points (i.e., 76.1 to 71.0 percent) in 1999. Figure 12 compares BTS' reported on-time arrival rates for the 10 air carriers with our adjusted arrival rates[21] for the last 5 years.

**Figure 12: Impact of Schedule Increases on Air Carriers' On-Time Arrival Statistics, 1995-99**




The extent to which air carriers have adjusted their flight schedules to account for growing gate-to-gate times is evident in the Newark to O'Hare route. As Figures 13 and 14 illustrate, Newark's average hourly taxi-out times (which ranged between 19 and 42 minutes) closely track the gate-to-gate times published in the air carriers' flight schedules (which ranged between 2 hours 6 minutes and

**Figure 13: Newark's Taxi-Out Times in 1999**

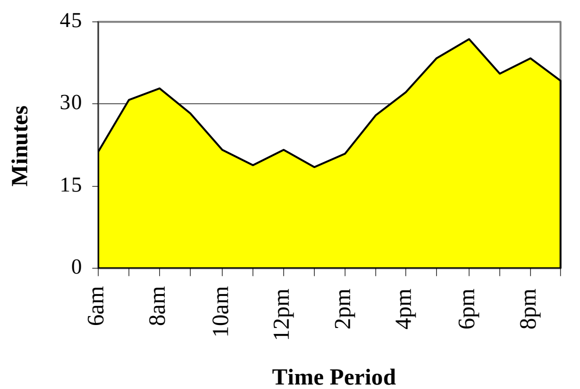
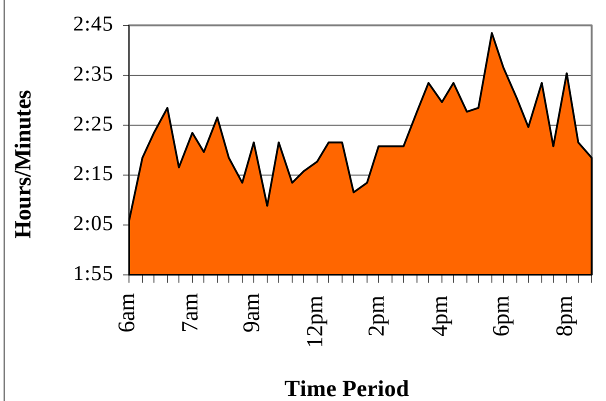



**Figure 14: Scheduled Flight Times for Newark to O'Hare, October 1999**




[20] To measure the full growth in flight schedules, we went back to 1988, the first complete year of BTS data on the 10 major air carriers.

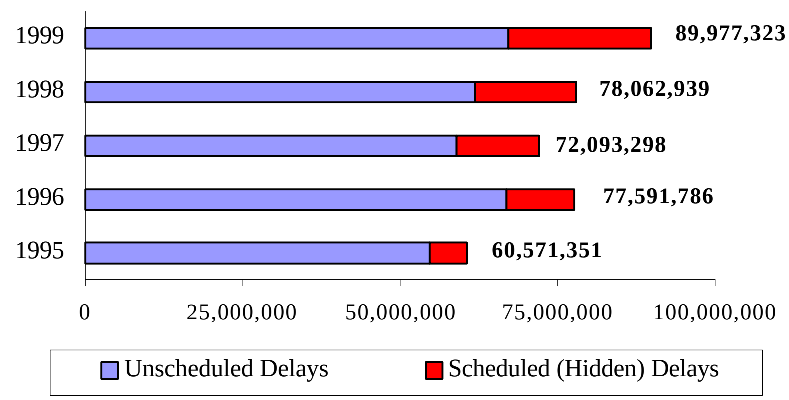
[21] The adjusted rates were calculated by deducting those flights that would have been recorded as delayed if the flight schedules had not been increased.

2 hours 44 minutes). Moreover, Newark's highest taxi-out time of 42 minutes occurred at 6 p.m., the same time as the longest flight schedule of 2 hours 44 minutes.

### *Actual Extent of Delays Is Much Greater Than Currently Reported*

The expansion of flight schedules (or gate-to-gate times) has masked the true extent of growing delays throughout the system. Since 1988, we calculated that these scheduled delays added nearly 130 million minutes of travel time for passengers and the air carriers. Figure 15 shows the amount of unscheduled and scheduled delays occurring each year since 1995.[22] It also indicates that scheduled

**Figure 15: Total Unscheduled and Scheduled Delays in 1999 (in minutes)**




delays are a growing portion of the air carriers' total flight delays. For example, in 1995, scheduled delays represented less than 10 percent of total delay time. By 1999, this amount had grown to 25 percent. (See Exhibit H for a listing of scheduled and unscheduled delays for the 28 airports.)

### *Consumer Flight Delay Indicator (CFDI)*

In an effort to measure the true growth in flight delays and the resulting impact on consumers (as well as on the air carriers), we developed the CFDI. Derived from BTS data, this indicator is based on an aggregation of the total delay minutes (both scheduled and unscheduled) per flight operation. As Figure 16 indicates, the CFDI has grown considerably, with the average delay time per flight flown by the

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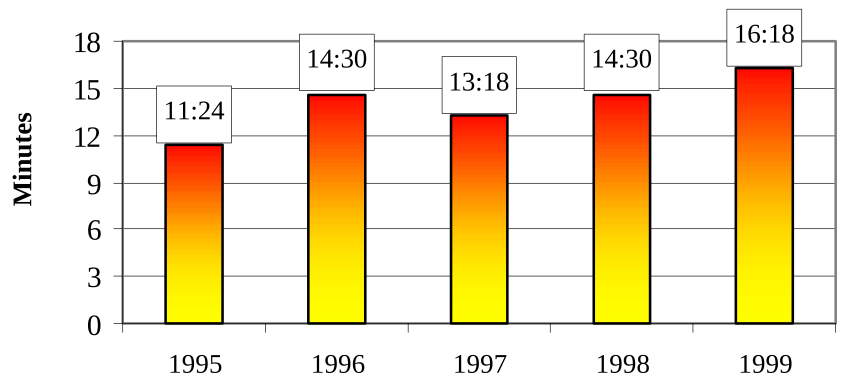
22 Unscheduled delays involve flights in which the actual gate arrival time exceeds the air carrier's scheduled gate arrival times. Scheduled delays involve flights in which the air carrier's scheduled block or gate-to-gate times have been increased to compensate for growing ground and air delays.

major air carriers increasing from 11 minutes and 24 seconds to 16 minutes and 18 seconds (or 43 percent) between 1995 and 1999. When applied to the individual airports, CFDI rates ranged from 11 to 27 minutes. (See Exhibit C for a description of the methodology used to calculate the CFDI as well as a listing of CFDI rates for the 28 major airports.)

**Figure 16: Consumer Flight Delay Indicator 1995-99**




### *Cancellations Have Also Increased*

Between 1995 and 1999, cancellations grew at even a faster pace than flight delays, going from 91,905 to 154,311, an increase of 68 percent. The rate of cancellations per total flight operations[23] also increased, going from 1.7 to 2.8 percent over this same time period, with many airports having cancellation rates far above the national average, including Boston (5.8 percent), LaGuardia (5.6 percent), O'Hare (5.4 percent), Washington National (5.3 percent), and Philadelphia (4.9 percent). We also found that the number of cancellations increased at all the major airports between 1995 and 1999, with the exception of St. Louis, which had a 13 percent decrease.[24] Table 6 lists the five airports with the largest percentage increases in cancellations over the last 5 years.

**Table 6: Airports with Largest Percentage Increases in Cancellations, 1995 and 1999 (BTS Data)**

| No. | Airport | 1995 | 1999 | # Increase | % Increase |
|---|---|---|---|---|---|
| 1 | Philadelphia | 1,775 | 5,683 | 3,908 | 220% |
| 2 | Charlotte | 1,708 | 4,477 | 2,769 | 162% |
| 3 | O'Hare | 6,188 | 15,985 | 9,797 | 158% |
| 4 | Atlanta | 2,887 | 6,859 | 3,972 | 138% |
| 5 | Orlando | 741 | 1,757 | 1,016 | 137% |

23 This is all commercial operations reported by the 10 air carriers to BTS.

24 Two possible explanations for the decrease in cancellations at St. Louis include a 3 percent decline in total flight operations there between 1995 and 1999 and the installation of new radar/landing equipment.

(See Exhibit I for the number and rate of cancellations for each of the 28 major airports and the 10 major air carriers.)

We also looked at the cancellation rates for major domestic routes. For heavy volume routes, the air carriers attributed their higher cancellation rates to aircraft substitution, with the air carriers tending to cancel flights in which passengers could be placed on later flights that same day as opposed to canceling a flight that occurred once a day. Table 7 cites five heavy volume routes that incurred cancellation rates three to five times the national average of 2.8 percent during 1999.[25]

**Table 7: Heavy Volume Routes with High Cancellation Rates in 1999 (BTS Data)**

| No. | Departure Airport | Arrival Airport | Percent Cancelled |
|---|---|---|---|
| 1 | Newark | O'Hare | 14.4% |
| 2 | O'Hare | Boston | 12.9% |
| 3 | Philadelphia | O'Hare | 12.6% |
| 4 | San Francisco | Los Angeles | 11.5% |
| 5 | Washington, DC | Boston | 9.6% |

## *Cost of Flight Delays and Cancellations*

The overall cost of flight delays and cancellations, for the air carriers, has been considerable. According to FAA, flight delays cost the air carriers over $3 billion annually. Likewise, the Air Transport Association estimated that delays cost the air carriers approximately $2 billion in direct operating costs in 1999. The Air Transport Association's amount increases to nearly $5 billion when indirect costs and the value of passengers' lost time are included. Likewise, we estimate that delays[26] and cancellations[27] cost the 10 major air carriers about $4.1 billion in 1999 (see Table 8).

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25 Cancellation rates cited in Table 7 were based on the first 9 months of 1999. When examining these routes further, we found that the likelihood of a flight being canceled also varied by air carrier. For instance, of the three major air carriers flying to and from Newark and O'Hare, we found that the cancellation rate for one air carrier was less than half the rate for the other two (8 percent versus 17 percent).

26 These calculations were based on air carrier estimates of their direct operating costs per minute in 1999, which ranged from $23 to $50 per minute.

27 Air carrier estimates of the cost of a canceled flight ranged from $3,500 to $6,684. This estimate includes direct costs such as flight crew salaries, but excludes costs associated with: (a) lost revenue, (b) paying passenger hotel costs and/or meals, (c) reimbursements and/or travel certificates for future travel, (d) the cost of paying other carriers to take stranded passengers, and (e) the potential for future lost revenue.

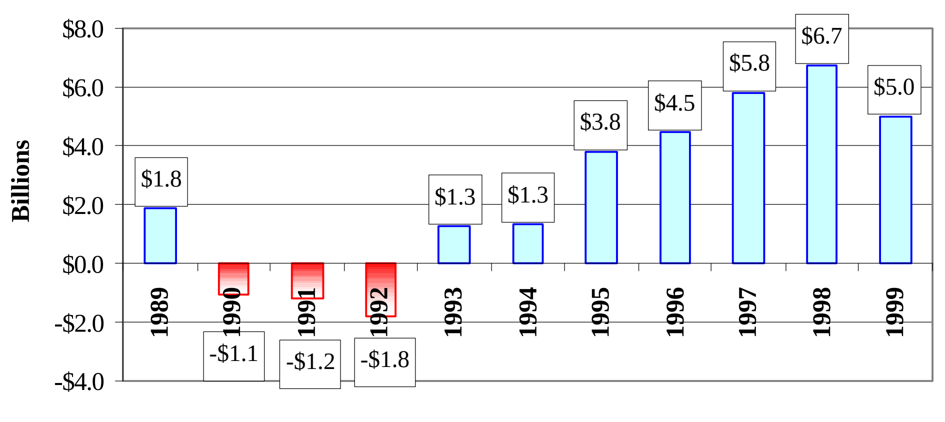
**Table 8: OIG Estimates of the Cost of Delays and Cancellations to the 10 Major Air Carriers, 1995-99 (in millions)**

| Year | Air Carriers Direct Costs (Delays) | Air Carrier Costs (Cancellations) | Total |
|---|---|---|---|
| 1999 | $3,284 | $786 | $4,070 |
| 1998 | $2,772 | $716 | $3,488 |
| 1997 | $2,520 | $477 | $2,997 |
| 1996 | $2,665 | $616 | $3,281 |
| 1995 | $2,012 | $426 | $2,438 |
| 5 Year Total: | $13,253 | $3,021 | $16,274 |

Unlike Air Transport Association's estimate, however, we included the costs associated with scheduled delays in our calculations. Overall, these scheduled delays added approximately $800 million in costs to the air carriers in 1999. (See Exhibit B for a full discussion of the methodology used in calculating the above cost figures and a complete listing of the costs associated with delays and cancellations at each of the 28 largest airports in 1999.)

Although the costs associated with delays and cancellations were sizeable in 1999, such costs must be measured against the amount of profits generated by the air carriers. We found that the 10 major air carriers, in total, generated $3.8 to $6.7 billion annually in operating profits between 1995 and 1998.[28] Although the air carriers' profits in 1999, at $5 billion, were less than those achieved in 1998 and 1997, they were still higher than all other years since 1989, as illustrated by Figure 17. These profits were achieved between 1995 and 1999, a period in which FAA-reported flight delays increased by 58 percent and BTS-reported cancellations increased by 68 percent.

**Figure 17: Operating Profits (Losses) for the 10 Largest Air Carriers, 1989-1999**



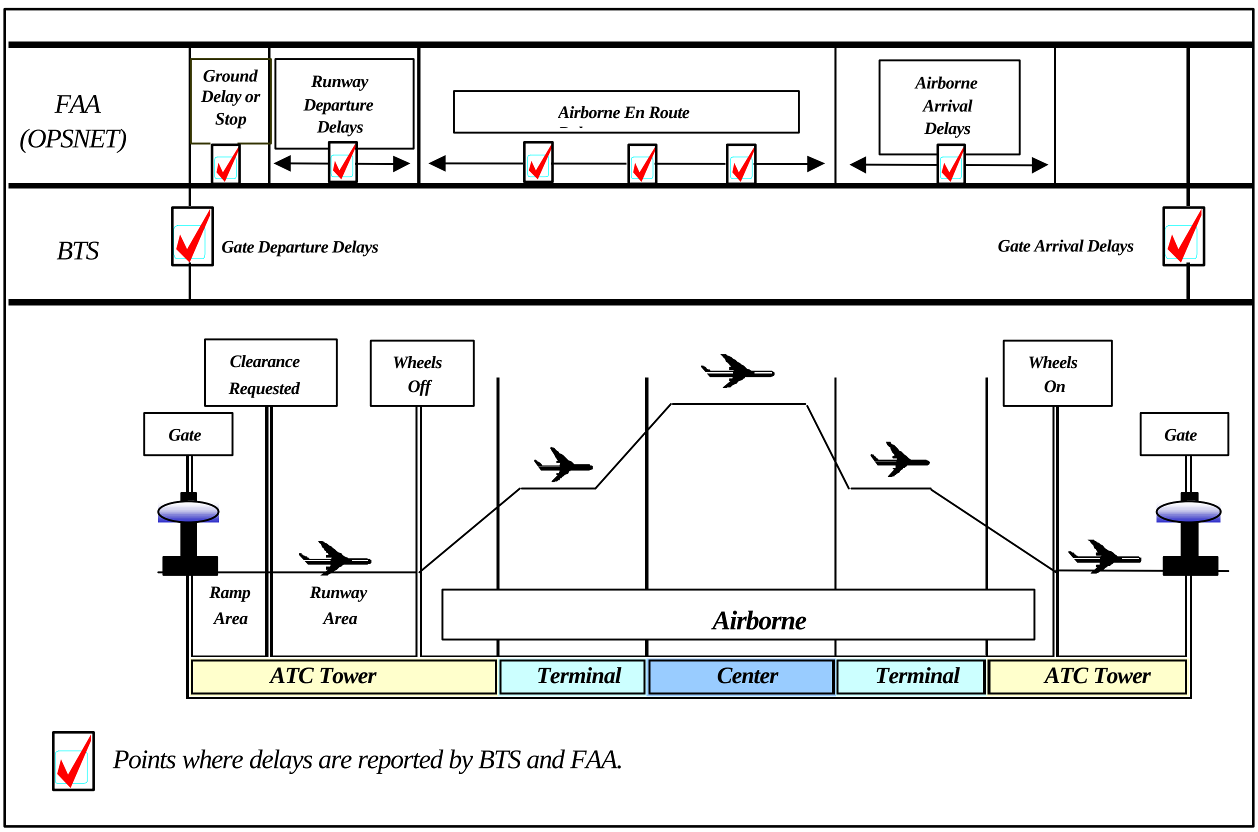

28 Operating profits represent the air carriers' profits prior to deducting taxes and non-operational expenses such as interest on capital leases and long-term debt.

# CHAPTER 2: SHORTFALLS IN CURRENT DATA

Although existing data provide an indication as to the extent and sources of flight delays and cancellations, various shortfalls exist in the methods used to record their occurrences. In particular, we found that no existing database (whether individually or combined) provides a complete picture of flight delays, cancellations, and their causes. This chapter discusses shortfalls in the methods used by FAA and BTS to track and record information on delays and cancellations.

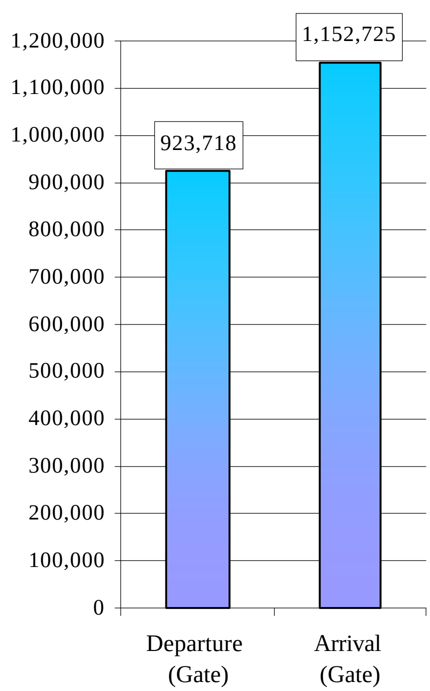
## *DOT Lacks Uniform Methodology for Tracking Delays, Cancellations, and Associated Causes*

We found FAA and BTS have very little in common with respect to what they consider a delay and how such delays are calculated. To illustrate this point, the following diagram was prepared, with *checkmarks* placed next to those flight segments tracked (for the purposes of recording delays) by FAA or BTS. As these checkmarks indicate, there is no commonality as to what the two organizations track. For FAA (using OPSNET), delays occur on the taxiway/runway and airborne (en route and arrival). For BTS, delays occur at the departure or arrival gates.



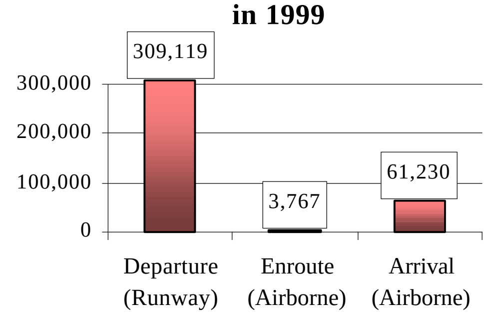
As shown in the diagram on page 14, the two organizations also have little in common with respect to how they determine delays, with the exception that both use a 14-minute allowance before a delay is recorded. For instance, BTS calculates a delayed departure as the difference between scheduled and actual departure from the gate. Thus, a flight departing 14 minutes after the scheduled departure time would be recorded as an on-time departure, whereas a flight departing 15 minutes after the scheduled departure time would be recorded as a 15-minute departure delay. In comparison, FAA calculates departure delays as the time difference between the pilot's request to taxi and wheels off, less the airport's standard unimpeded taxi-out time.[29] As a result, a flight taking 25 minutes between the pilot's request to taxi and wheels off would be recorded as a 15-minute departure delay, assuming an unimpeded taxi-out time of 10 minutes.

**Figure 18: Number and Categories of BTS Delays in 1999**




As could be expected, these differing methodologies resulted in significant differences in the number of flight delays reported. BTS, for example, reported 2,076,443 delays in 1999. In comparison, FAA only reported 374,116 delays. Figures 18 and 19 show the number and categories of delays reported by BTS and FAA in 1999.[30]

**Figure 19: Number and Categories of OPSNET Delays in 1999**

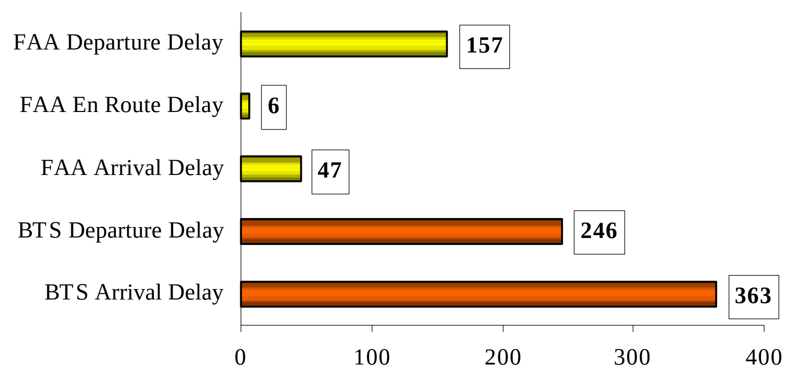



[29] At the airports visited during our audit, the standard unimpeded taxi-out time ranged between 5 and 20 minutes.

[30] Included in FAA's departure delay category are flight delays associated with traffic management initiatives (TMI). These are delays enacted by or coordinated through the David J. Hurley Air Traffic Control System Command Center (National Command Center) at Herndon, Virginia, to manage the flow of air traffic.

Our own sample of flights identified significant differences between the number of delays identified using BTS' and FAA's methodologies. From November 1 through 5, 1999, we tracked 1,690 flights between Atlanta, Dallas/Ft. Worth, O'Hare, and Newark airports. Of these flights, we identified 246 departure and 363 arrival delays (as well as 108 cancellations) using BTS' criteria, for a total of 609 flight delays (see Figure 20). In comparison, we identified 157 departure, 6 en route, and 47 arrival delays using FAA's criteria, for a total of 210. Overall, BTS criteria resulted in 399 more delays than FAA's.

**Figure 20: OIG Sample of 1,690 Flights (November 1 through 5, 1999)**

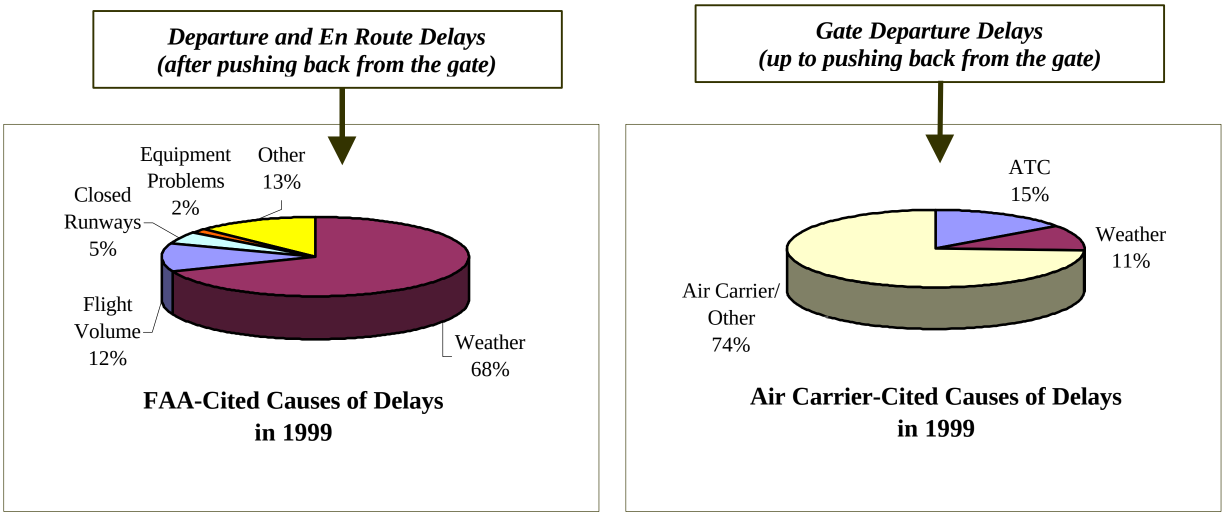



### *Significant Lack of Agreement and Incomplete Data Fuel Controversy Over Causes of Delays*

We found significant disagreement within the aviation community as to the causes of flight delays and cancellations. The Air Transport Association, for example, blames FAA and weather for most delays. In contrast, FAA points to weather and flight volume as the main factors. The lack of consistent and complete causal data has only fueled this debate, with no one system possessing a full picture of the causes of flight delays and cancellations. For example, BTS does not collect causal data for delays or cancellations. FAA only collects causal data on delays reported through OPSNET, but maintains no comparable information on cancellations. Moreover, FAA causal codes do not cover delays due to air carrier activities, such as aircraft maintenance, lack of aircraft or flight crew, boarding of passengers, or fueling. While most of the air carriers maintain causal information for internal purposes on both delays and cancellations, those causes are associated primarily with gate departure delays (up to the aircraft pushing away from the gate), and generally are not consistent with the causal information collected by

FAA.  Figure 21 highlights the large differences between FAA and air carrier causal data for flight delays.[31]

**Figure 21:  FAA- and Air Carrier-Cited Causes for Delays in 1999**




As Figure 21 shows, the air carriers attributed 74 percent of *gate departure delays* to such factors as:  (1) scheduled and unscheduled aircraft maintenance, (2) ground services (e.g., aircraft fueling, baggage, and catering), (3) customer service issues, and (4) late arriving aircraft and/or crew in which the underlying cause for tardiness (e.g., weather, ATC, and dispatch) is not clearly identified. The air carriers pointed to ATC (15 percent) and weather (11 percent) as causing the remaining amount of gate departure delays.  The air carriers also attributed 54 percent of the cancellations in 1999 to air carrier/other factors, followed by weather (32 percent) and ATC (14 percent).

Once the aircraft left the gate and came under ATC control, FAA OPSNET data identified weather as causing 68 percent of the departure and en route delays in 1999, followed by flight volume (12 percent), closed runways (5 percent), ATC and airport equipment problems (2 percent), and other[32] (13 percent). FAA-imposed ground delays and stops, which can impact flights both at the gate and during the taxi-out phase, is the only area where both FAA and the air carriers record causal data—although such data will frequently differ (e.g., FAA citing weather and the air carriers citing ATC).  In addition, if the aircraft pushes away

31 Causal data were obtained from 8 of the 10 largest air carriers for gate departure delays of 15 minutes or more.

32 For FAA, the other category includes emergency conditions or other special nonrecurring activities, such as an air show, VIP movement, or radio interference.  International delays are also included in this category.

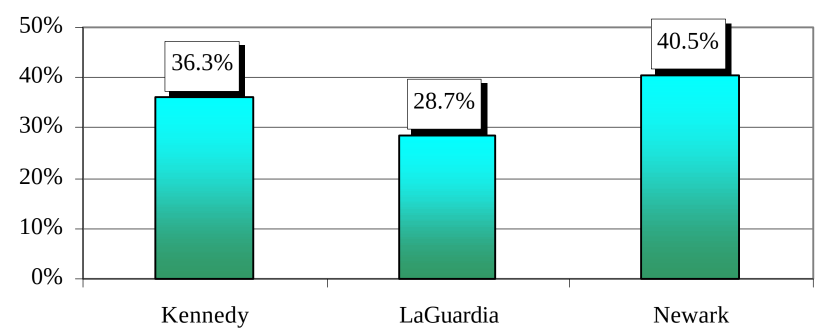
from the gate prior to FAA imposing a ground delay or stop, then only FAA would record any causal data. During the taxi-in phase (after the aircraft has landed), we found that neither FAA nor the air carriers maintained causal data, even though taxi-in delays represent approximately 8 percent of total delay time in 1999.[33]

The lack of consistent, uniform causal data—covering all flight phases—has led to substantial disagreements over the sources of delays. Whereas FAA cites weather as a major cause, the air carriers question the agency's management of air traffic during poor weather conditions. Likewise, the air carriers point to outdated ATC equipment and inefficient air traffic management practices, while FAA cites new equipment, increasing flight volume, and limited system capacity. Without good causal data, it is unlikely that the current debate within the aviation community will end, nor will the increasing number of flight delays and cancellations. It is critical, therefore, that both FAA and the air carriers work together in developing a common set of categories for reporting causal information on flight delays and cancellations—as called for by The Wendell H. Ford Aviation Investment and Reform Act for the 21st Century.

### *Current Databases Do Not Fully Address Sources of Most Delays*

Neither FAA's nor BTS' methodology fully addresses the time spent on the ground, the largest source of increasing delays and gate-to-gate times. As noted earlier, BTS focuses on the start and end points of a flight by tracking delays in gate departures and arrivals. Whereas FAA does monitor the time an aircraft is on the ground while under the agency's control (normally on the runway), it does not track the time spent in the ramp area (normally under air carrier control). Time spent in the ramp area, however, can represent a significant portion of the overall taxi-out time. As Figure 22 indicates, ramp time comprised from approximately 28.7 to 40.5 percent of the

**Figure 22: Ramp Time as a Percent of Total Taxi-Out Time at 3 New York Area Airports, 1997-99**




33 Percentage breakout of taxi-in delays was derived from FAA's Consolidated Operations and Delay Analysis System (CODAS).

average taxi-out time at Kennedy, LaGuardia, and Newark between 1997 and 1999.[34]

### *Current Databases Provide Confusing Information to Consumers on Flight Delays*

From the standpoint of air travelers, we found FAA's and BTS' methodologies confusing in how delays are determined. For instance, FAA calculates departure delays as the difference between the time a pilot requests FAA clearance to taxi and the time an aircraft's wheels lift off the runway, minus the airport's standard unimpeded taxi-out time.[35] Under this methodology, a flight could sit at the gate or ramp area for several hours before requesting clearance to taxi. So long as the flight, once under FAA's control, took off within 15 minutes of the airport's standard taxi-out time, the flight would be considered an on-time departure, as illustrated by our first example.[36]

***EXAMPLE 1***: On November 2, 1999, United Airlines flight 645 from Newark to O'Hare left the gate 68 minutes late due to mechanical problems. Because this delay took place at the gate, it incurred a departure delay as defined by BTS. Once repaired, however, the flight took off within 24 minutes of receiving FAA's clearance to taxi. Because the total time period between the request for taxi and wheels off did not exceed the allotted taxi-out time of 29 minutes at Newark, FAA did not record a departure delay.

In comparison, BTS calculates a delayed departure as the difference between scheduled and actual departure from the gate. Under this methodology, a flight could sit several hours in the ramp area or on the runway and BTS would still consider it an on-time departure, as long as it left the gate within 15 minutes of the scheduled departure time, as illustrated by our second example.

***EXAMPLE 2***: On November 1, 1999, American Airlines flight 1599 from Newark to O'Hare departed the gate at the scheduled time. As such, it achieved an on-time departure as defined by BTS. Because of an FAA ground delay, the aircraft remained in the ramp/taxiway an additional 113 minutes before takeoff. FAA, therefore, recorded a departure delay since the elapsed period far exceeded Newark's allotted taxi-out time of 29 minutes.

We also found that BTS' ranking of the air carriers' on-time arrival rates was somewhat confusing to air travelers, since these rates can be influenced by the

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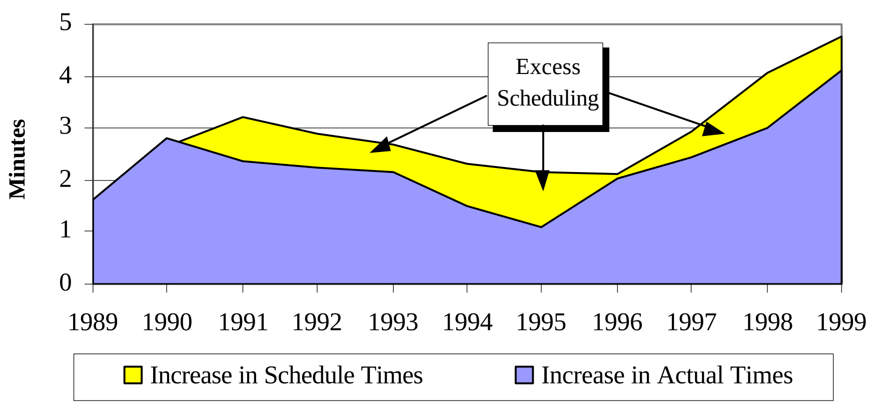
[34] Data supporting this chart came from Aviation Data Systems (ADS). ADS is a contractor hired by the Port Authority of New York/New Jersey to collect and analyze data from LaGuardia, Newark, and Kennedy airports. Unlike existing FAA and BTS information, ADS data allowed for the subdivision of ramp time from the overall taxi-out time. San Francisco is the only other major airport at which flight data are collected by ADS.

[35] According to FAA, unimpeded taxi-out time is the taxi-out time under optimal operating conditions, when congestion, weather, and other factors do not delay the aircraft during its movement from gate to takeoff. Unimpeded taxi-out time varies by airport, depending on the airport configuration.

[36] Such a flight would be recorded as arriving late, unless the lost time was made up en route or the taxi-out delay had been factored into the air carrier's schedule for the flight.

amount of time inserted into the flight schedule. In other words, if a flight normally takes 2 hours to complete, by scheduling an additional 10 or 15 minutes, the air carrier can improve the odds that the flight will arrive on time. Overall, we

**Figure 23: Growth in Excess Scheduling**




found that the air carriers' published schedule time exceeded the actual gate-to-gate time in 9 of the last 11 years, as illustrated by Figure 23. This excess scheduling, on average, ranged from 7 seconds in 1996 to over 1 minute in 1995 and 1998.[37] It is also important to note that the on-time arrival rate for 1996 was significantly lower than rates achieved in either 1995 or 1998—the 2 years with the largest excess scheduling (e.g., 74.5 percent versus 78.6 and 77.2 percent, respectively).[38]

A key reason for differing data maintained by FAA, BTS, and the air carriers is in how each uses the information it collects. For FAA, delay information serves to measure system-wide ATC performance and to identify areas for improvement. For BTS, measuring delays (and subsequent ranking of air carriers by on-time arrival performance) serves as a source of air travel information to consumers and helps ensure more accurate reporting of flight schedules by the air carriers.[39] For the air carriers, gate departure delays and cancellations (and their causes) are the areas over which they see themselves as having the greatest control (as opposed to the taxi-out and en route portions of a flight, which are seen as being under FAA's

[37] Excess scheduling occurs whenever the flight schedule exceeds the actual gate-to-gate times for a flight or set of flights (i.e., route). This analysis involves a weighted average of all domestic routes flown by the 10 air carriers between 1989 and 1999.

[38] We also found that as the excess schedule time increased, so did the number of early arrivals (flights that arrive prior to their scheduled gate arrival time). For example, approximately 46 percent of flights arrived 1 minute or more early in 1998 and 1999, as compared to only 40 percent in 1996.

[39] During the 1980s, flight schedules became a major marketing tool, with air carriers publishing unrealistically short timeframes in an effort to attract passengers. With the advent of DOT's ranking of the air carriers on-time arrival rates in 1988, such practices became less prevalent, as published schedules were increased to reflect actual flight times (as well as to avoid incurring arrival delays).

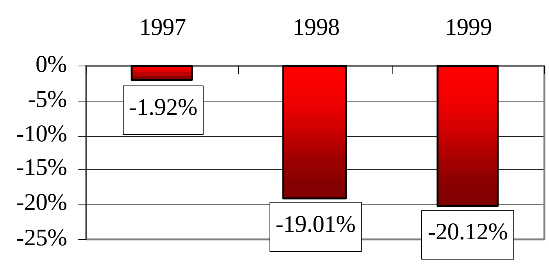
control). Because of these differences, however, the data reported by FAA and BTS can cause confusion for policy makers and the general public when one organization records a flight as on time and another organization records it as delayed.

### *Shortfalls in Baseline and Performance Data Associated With Flight Delays*

DOT's FY 2000 Performance Plan, issued in compliance with the Government Performance and Results Act of 1993, called for a 20 percent reduction in volume- and equipment-related delays and a 1 percent reduction in weather delays in FY 2000 (from base years 1992 to 1996). Our audit, however, identified problems with the baseline and performance data (i.e., OPSNET delay reports) used to measure achievement of these targets.

We found shortfalls in the baseline period (1992 to 1996) used to measure DOT's FY 1999 performance, in that FAA changed its method for calculating volume-related delays in 1997, resulting in a significant reduction in this category of delays. According to the Manager of FAA's National Command Center, many facilities in the past had incorrectly classified flight delays as due to excessive demand or volume instead of weather conditions. This included situations in which visibility might be good, but the airport was operating at less than optimum levels due to wind conditions. As Figure 24 illustrates, volume-related delays dropped significantly after the change in policy took effect in 1997. DOT's FY 1999 Report, FY 2001 Performance Plan (March 2000) notes that FAA exceeded its goal of reducing volume-related delays in 1999. However, this document also acknowledged that some of the decrease may be attributed to the 1997 methodology change, and a new performance measure will be used in FY 2000 that will include all OPSNET-reported causes of delays.

**Figure 24: Percent Change in Volume-Related Delays from 1992-1996 Base Period**




FAA's quality assurance process is limited in its ability to ensure the accuracy and reliability of OPSNET data. FAA facilities indicated that they do not have the time or the resources to verify the accuracy of the manual delay count reported in OPSNET. To perform quality assurance, the National Command Center and FAA regional offices perform spot checks of OPSNET delay data. When questionable delay entries are found, the responsible facility is notified and asked to review and correct the potential discrepancy. Yet, we found that this did not ensure that corrections were made in OPSNET. At Memphis International Airport, the National Command Center had notified air traffic control staff of data entry errors. FAA, however, did not take corrective actions until after the data errors were cited by the national media.

***MEMPHIS DATA ERRORS***

During August 1999, the national media reported (based on FAA data) that flight delays at Memphis International Airport increased by 844 percent, from 88 to 831 delays, during the first 5 months of 1999 compared to the same period in 1998. This was the largest delay increase reported by any U.S. airport during that time period. However, after further investigation, FAA found that it had overstated flight delays at Memphis by 700 percent (616 delays). This error occurred because air traffic control officials made incorrect data entries in OPSNET. The Memphis air traffic control manager acknowledged the mistake and stated that similar errors are likely occurring at other FAA facilities.

Many air traffic control officials we interviewed considered delay reporting a low priority. They saw very few benefits from OPSNET and stated the data entry process was an administrative burden that needed to be fully automated. Moreover, according to these officials, OPSNET delays are underreported at many facilities, in some cases as much as 30 percent. This is especially the case with en route delays, which are rarely reported. For instance, en route delays are reported whenever an FAA center imposes a delay of 15 minutes or more on an airborne flight. OPSNET, however, does not provide for the accumulation of multiple en route delays. As such, delays could be imposed on a single flight by several centers, which in total are greater than 15 minutes, but individually do not reach the 15-minute threshold for reporting a delay.

Based on these concerns, several FAA facilities have initiated programs aimed at automating OPSNET data entry. For example, the air traffic control staff in Atlanta is developing a system called the Airport Resource Management Tool. This tool uses bar-coded flight strips that are electronically scanned to automatically track and record flight delays. They believe that this system will increase the accuracy of delay reporting and reduce the time spent entering delay data in OPSNET.

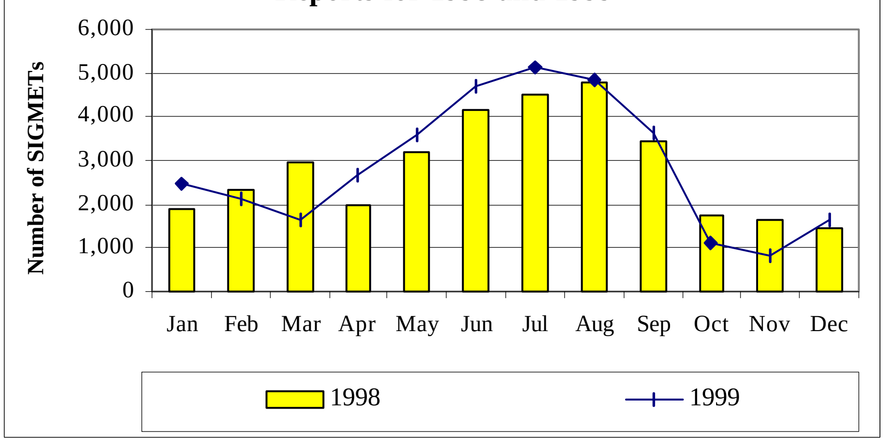
# CHAPTER 3: MAIN CAUSES OF FLIGHT DELAYS AND CANCELLATIONS

Both FAA and the air carriers identified a number of causes for flight delays and cancellations in 1999. This chapter summarizes the causal information maintained by FAA and the air carriers, and discusses one of the continuing themes we heard throughout our audit—that flight volume is nearing and in some areas, exceeding the capacity of the National Airspace System. As such, any event, be it a thunderstorm, equipment outage, or disabled aircraft, that restricts capacity can or does have significant ramifications, both locally and, in many cases, nationally. As part of our analyses, we identified five factors affecting capacity, and, in turn, increasing the number of flight delays and cancellations. These factors are examined in this chapter as well as actions being taken by FAA to improve the agency's management of air traffic and to develop a common system for tracking delays and cancellations.

## *FAA and Air Carrier Causal Data Point to Weather as a Major Source of the Increase in Delays in 1999*

Although FAA and air carrier causal data differ in many ways (as discussed in Chapter 2), we found some agreement when looking at the *sources for the increasing number of delays in 1999*. For instance, both FAA and the air carriers identified poor weather—especially during the spring and summer of 1999—as causing about 43 percent of the increase in delays from 1998. We found support for this conclusion in weather data maintained by the National Weather Service (NWS). As Figure 25 indicates, NWS reported a higher number of Significant Meteorological Events (SIGMET)[40] during the spring and summer months of 1999 than in 1998.

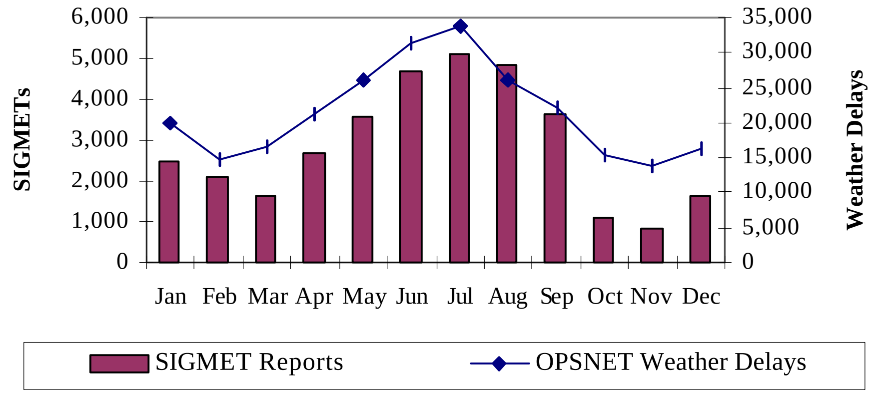
**Figure 25: National Weather Service SIGMET Reports for 1998 and 1999**




[40] SIGMETs are reports of any weather patterns that may be deemed hazardous to all aircraft, such as thunderstorms (convective) and snow or ice storms (non-convective).

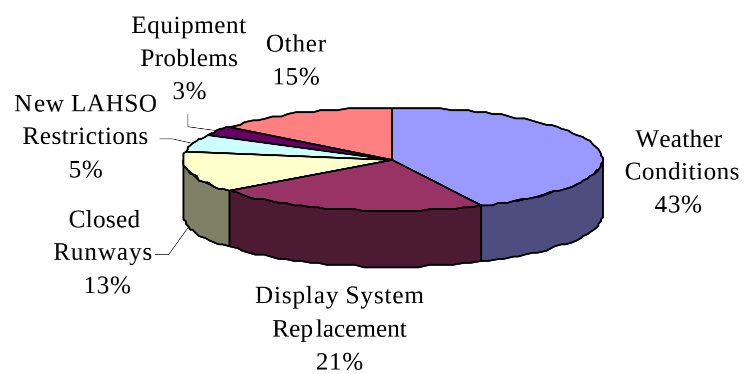
The close relationship between weather and flight delays is further illustrated by Figure 26. Overall, we found the trend lines for OPSNET weather-related delays and SIGMET reports in 1999 to be similar.

**Figure 26: OPSNET Weather Delays versus SIGMET Reports in 1999**




Using OPSNET data, we identified several causes for the increases in delays in 1999 (see Figure 27). In addition to weather, these causes included the installation of Display System Replacement monitors at FAA's en route centers, closed runways, new restrictions on Land and Hold Short Operations (LAHSO),[41] ATC or airport equipment problems, and other factors.

**Figure 27: Sources of Increases in FAA-Cited Delays in 1999**




## *Most Flight Delays and Cancellations Occur When Capacity Is Exceeded and/or Restricted*

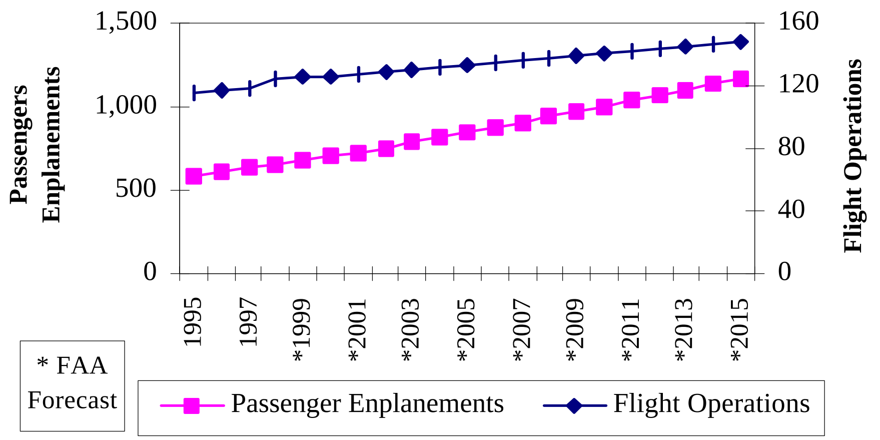
Most delays and cancellations occur once capacity at an airport or in the airspace is exceeded (demand) and/or reduced (supply). Other than poor weather, we identified five salient factors causing flight delays. The first three factors relate to excess demand, including the growth in flight volume, air carrier scheduling practices, and increased use of regional jets. In contrast, the last two factors relate to reduced supply, including new LAHSO restrictions and FAA equipment and traffic management practices. A brief discussion of these factors follows.

[41] LAHSO is an air traffic control procedure that permits the issuance of landing clearances to aircraft to land and hold short of an intersecting runway, taxiway, or other designated point on the runway. It is a procedure designed to increase airport capacity and to more efficiently move aircraft within the terminal airspace and on the airport surface.

### *Factor 1: Growth in Flight Volume*

FAA projects that flight operations and passenger enplanements will increase nearly 28 and 102 percent, respectively, between 1995 and 2015.[42] Much of this increase will take place at the 28 largest airports, which will comprise about 21 and 70 percent, respectively, of the growth in flight operations and passenger enplanements over this time period. Figure 28 illustrates the steady growth of flight operations and passenger enplanements since 1995, as well as FAA's future forecasts.

**Figure 28: Projected Growth in Enplanements and Flight Operations, 1995-2015 (in millions)**




Some of these airports and the surrounding airspace have already exceeded existing capacity, resulting in significant delays.[43] A good example is the airspace around Kennedy, LaGuardia, and Newark airports, where congestion has led to substantial increases in taxi-out out times. Based on our analysis of BTS data, we found that the average taxi-out times at these three airports had increased nearly 30 percent over the past 5 years. While flight operations at these airports have been fairly constant, especially over the last several years, growing flight operations at nearby airports as well as flights passing over the New York City area have seriously increased airspace congestion.[44] If current trends were to

42 Projections were derived from FAA's Terminal Area Forecast System.

43 For instance, FAA's Aviation Capacity Enhancement Plan (dated 1998) notes that all but three major airports in the United States exceeded 20,000 hours of delay in 1997. By 2007, all but one are projected to exceed 20,000 hours.

44 Between 1995 and 1999, the number of flight operations at Kennedy, LaGuardia, and Newark increased 6 percent. In comparison, two nearby airports (Teterboro and Westchester County), that compete for the same terminal airspace as the three larger airports, saw flight operations increase nearly 20 percent. The number of en route flights handled by the New York Center also increased over 35 percent during this same time period.

continue unabated, we estimate that the average taxi-out times for these airports could well surpass 1 hour in the next 10 years, with some times as high as 1 ½ hours during peak periods. Figures 29, 30, and 31 compare the *average* taxi-out times (by hourly increments) at Kennedy, LaGuardia, and Newark in 1999 with our estimates for 2010, if current trends did continue.[45]

When physical capacity constraints remain unresolved, air carriers would likely reduce their projected growth in flight operations to avoid high levels of delays that would be unacceptable to their passengers and costly for them. Instead, airfares from these airports would likely increase to restrain demand to a level commensurate with capacity.

On a national level, various actions have been taken to improve airport and airspace congestion. For example, between 1995 and 1999, a total of 9 new runways were opened at the Nation’s 100 largest airports.[46] Efforts to increase capacity have already resulted in some decline in delays. The five airports with the greatest reduction in OPSNET delays

**Figure 29: Kennedy's Average Taxi-Out Times, 1999 vs. 2010**

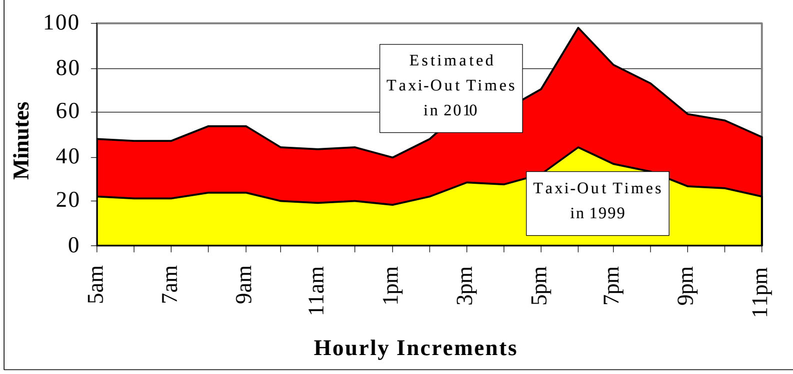



**Figure 30: LaGuardia's Average Taxi-Out Times, 1999 vs. 2010**

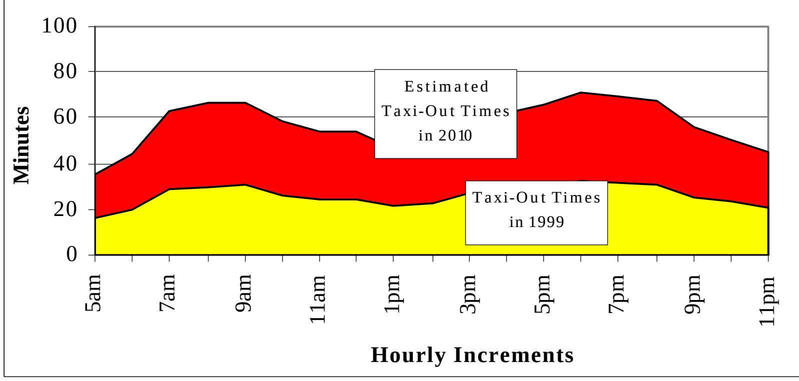
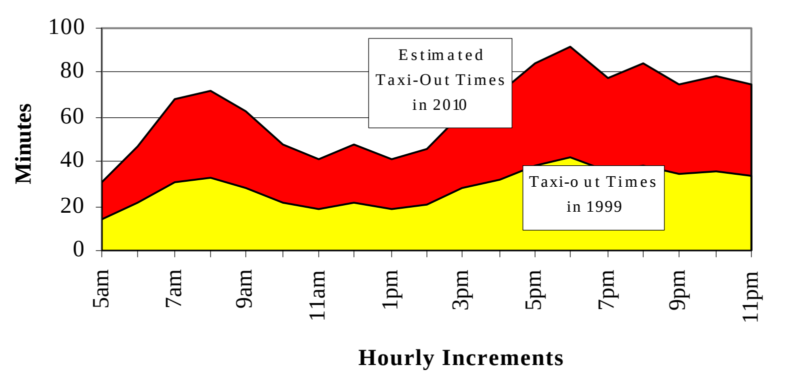



**Figure 31: Newark's Average Taxi-Out Times, 1999 vs. 2010**

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45 Our estimates were based on average taxi-out times for the three main New York area airports, which have grown at an annual rate of 7.42 percent between 1995 and 1999.

46 Only 3 of the 9 new runways were constructed at the 28 major airports--Salt Lake City (1995), Dallas/Ft. Worth (1996), and Philadelphia (1999).

between 1995 and 1999 (see Exhibit D), all saw some improvements in capacity during this time period. For instance, Denver opened a new airport; Charlotte and St. Louis installed new radar/landing equipment, Salt Lake City added a new parallel runway, and Los Angeles resolved an airspace dispute. As the description in the box illustrates, airspace redesign and airport enhancements both helped to reduce delays at the Dallas/Ft. Worth airport.

**_DALLAS/FT. WORTH AIRSPACE AND AIRPORT IMPROVEMENTS_**

In 1996, FAA completed a major redesign of the airport's surrounding airspace, increasing by 40 percent the number of aircraft that could safely fly in and out of Dallas/Ft. Worth under Visual Flight Rules (VFR) conditions. In addition, FAA provided funds for a seventh runway, which was also completed in 1996. Due to the increased capacity from these two efforts, Dallas/Ft. Worth airport was able to reduce the number of OPSNET delays by 29 percent (as compared to a nationwide increase of 58 percent), while handling approximately the same number of flights over the last 5 years.

In comparison, the five airports with the largest percentage increases in OPSNET delays (Philadelphia, Las Vegas, Cincinnati, Seattle, and Phoenix) all experienced problems associated with growing air traffic at the airport and/or in the surrounding airspace.

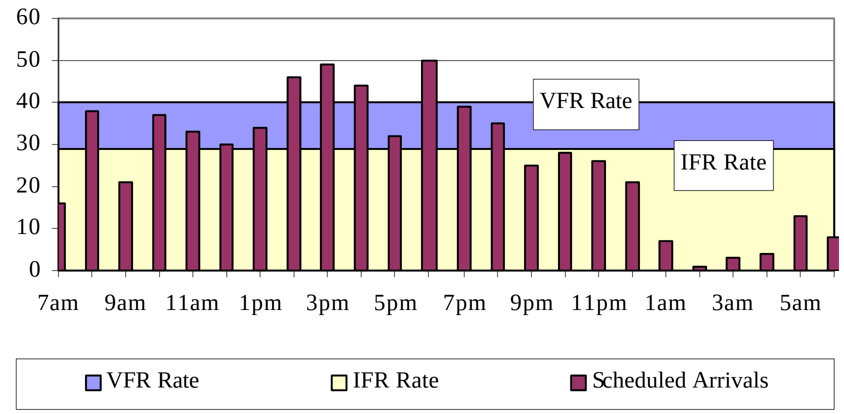
### *Factor 2: Air Carrier Scheduling Practices*

In addition to the overall growth in flight volume, we found that air carriers schedule departures at some airports above their capacity under ideal conditions (e.g., clear weather and all runways available). Specifically, we found that the air carriers concentrate their departures and arrivals into peak periods of airport operations (e.g., morning and evening). Furthermore, delays that occur because of the air carriers' scheduling practices are significantly increased if weather conditions deteriorate. Generally, the number of departures and arrivals an airport can handle are contingent upon weather conditions specified by FAA's Visual and Instrument Flight Rules (VFR and IFR, respectively).[47] Under IFR conditions, the number of aircraft that can depart and land safely is reduced from VFR (more optimum) conditions. Yet, air carriers frequently schedule their flights at, or above, the VFR rate, especially during peak periods of operation (morning and evening rush hours).

[47] If visibility levels fall below the minimum VFR conditions, then IFR conditions govern flight operations.

As illustrated by Figure 32, Newark's scheduled arrivals on January 12, 2000, exceeded its capacity, even under VFR operations, for 4 hours. If the airport went to IFR operations, the number of hours in which scheduled arrivals exceeded the airport's capacity would increase to 12 hours.

**Figure 32: Newark's Scheduled Arrivals vs. VFR and IFR Rates (January 12, 2000)**

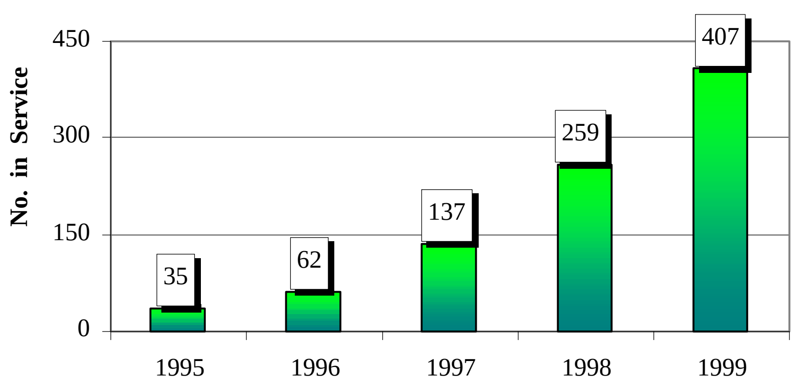



### *Factor 3: Increased Use of Regional Jets*

The growth in the use of regional jets by regional air carriers[48] has also contributed to increases in delays. Several members of the aviation community told us that potential consequences of this growth include: (1) increased congestion in high altitude en route airspace, (2) longer miles-in-trail (MIT) separation restrictions,[49] (3) congestion in terminal airspace, and (4) increased runway demand. These problems could become exacerbated as regional jets become a larger share of the domestic air carrier fleet.

As shown in Figure 33, the number of regional jets in service grew more than 10-fold between 1995 and 1999. By the end of 1999, 407 regional jets were in service, with another 524 on order and options for 755 more. The Mitre Corporation estimates that the use of regional jets will continue to grow at a rate of

**Figure 33: Growth in Regional Jets, 1995-99**




48 The 97 regional air carriers in the United States provide short-haul scheduled passenger and freight service connecting small- and medium-sized communities with larger cities and major airports. In recent years, regional air carriers have been replacing, or augmenting, their turbo-prop fleets with regional jets.

49 Miles-in-trail or MIT is an ATC tool that intentionally paces traffic by increasing spacing between aircraft to keep volume at manageable levels. This spacing between aircraft should not be confused with the FAA safety separation standards requirement of 5 nautical miles laterally or 2,000 feet in altitude, in sectors of high-altitude traffic.

25 percent annually. Moreover, FAA estimates that regional jets will make up 19 percent of the total domestic fleet by 2011. According to the Regional Airline Association, regional jets will replace many of the smaller turbo-prop and propeller-driven aircraft currently in service.

Although the transition to regional jets allows regional air carriers to transport the same number of passengers with fewer aircraft, the use of such aircraft actually adds volume to high-altitude en route and terminal airspace. Propeller-driven aircraft traditionally used by regional air carriers generally operate below 24,000 feet. However, regional jets operate most efficiently at altitudes above 24,000 feet, the same airspace where larger commercial jets operate. As regional jets gradually supplant propeller-driven aircraft, the potential exists for increased congestion in the en route airspace.

Similarly, in the terminal airspace environment, arrival and departure routes are generally designed to accommodate separate propeller and jet aircraft operations. Unlike propeller aircraft, a regional jet's climb and decent performance is similar to that of larger commercial jets. As a result, regional jets again compete for routes designed for the larger commercial jets, resulting in greater terminal airspace congestion, while those routes designed for turbo-prop operations become underutilized.

Regional jets can also change the way existing airport capacity is used. According to FAA officials, Newark and Boston airports have experienced reduced capacity as more regional jets replace turbo-prop aircraft and compete for slots on longer main runways, leaving shorter commuter runways underused. At Newark, in particular, the Air Traffic Manager estimates that the transition from turbo-prop aircraft to regional jets has resulted in 90 additional operations per day on the main runways, and a 60 to 70 percent drop in the use of its commuter runway.

### *Factor 4: New LAHSO Restrictions*

LAHSO is an air traffic control procedure designed to increase airport capacity and to more efficiently move aircraft within the terminal airspace and on the airport surface. This procedure permits an air traffic controller, under certain circumstances, to clear an aircraft to land and hold short of an intersecting runway, taxiway, or other designated point on the runway. As a result, flights can take-off and land simultaneously on intersecting runways, thereby reducing the amount of time departing flights have to wait for takeoff (and, in turn, minimizing delays on the ground). Prior to April 1999, LAHSO was used at more than 220 airports in the United States.

On March 26, 1999, FAA issued Notice 7110.199 based on an agreement with the Air Line Pilots Association and the Air Transport Association. This notice restricted the use of LAHSO to 25 airports under certain conditions (i.e., dry, calm weather with minimum visibility of 3 miles). It also revised the minimum stopping distances required for LAHSO operations and placed many smaller aircraft (including some turbo-props and regional jets)[50] in the same category as larger passenger jets. As a result, some turbo-prop aircraft and regional jets were no longer eligible for LAHSO clearances on certain commuter runways.

Restrictions on the use of LAHSO procedures have adversely affected departure and arrival capacity at several airports, including: Boston, LaGuardia, O'Hare, Philadelphia, and Newark. For example, FAA and air carrier officials estimate that LAHSO restrictions reduce O'Hare's arrival rate by about 10 to 20 flights per hour, which creates a "ripple effect" of slowed arrivals throughout the day, often resulting in delays. Likewise, the Air Traffic Manager at LaGuardia noted that the new order prohibits using LAHSO on one of the airport's two runways, resulting in six fewer departures per hour. Finally, the Air Traffic Manager at Philadelphia attributed 278 departure delays between April and July 1999 to the inability to use LAHSO procedures.

### *Factor 5: FAA Equipment and Traffic Management Procedures*

In our meetings with officials from the air carriers and the Air Transport Association, a number of FAA equipment and traffic management problems were cited as causing the rapid increase in delays and cancellations in 1999. One of the most significant issues was FAA's installation of Display System Replacement monitors at several of its major centers, including Chicago, Cleveland, and New York. In its October 14, 1999 report on flight delays,[51] the Air Transport Association noted that the aviation industry saw a *". . . dramatic increase in April delays when the FAA began their transition of the Cleveland Center to the new long-awaited Display System Replacement. The FAA needed a reduction in demand on this center's airspace, to allow controllers to become proficient on the new equipment, and put intentional delays in place by increasing miles-in-trail restrictions up to 60-miles between aircraft."*

Partly in response to the rapid increase in delays and cancellations as well as rising complaints,[52] FAA (along with representatives of the airline industry) conducted an extensive evaluation aimed at improving air traffic management. The

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50 The major distinctions between the two types of aircraft is that turbo-props are propeller-driven aircraft that generally fly at slower speeds, lower altitudes, and require shorter runways for takeoff and landing than regional jets.

51 Approaching Gridlock: Air Traffic Control Delays, Air Transport Association, Departments of Air Traffic Management and Economics, October 14, 1999.

52 The number of consumer complaints DOT received relating to flight delays increased 528 percent between 1998 and 1999. At the same time, all aviation-related complaints received by DOT increased 113 percent.

evaluation found several inefficiencies that compounded delay problems during the summer of 1999. For example, the FAA evaluation found that because traffic management specialists in the National Command Center used different weather radar information than controllers in facilities across the Nation, disputes erupted between the National Command Center and field facilities over rerouting flights around weather events. In addition, FAA found that specialists in the National Command Center and traffic management coordinators in the field did not always understand the impact of their individual actions on the National Airspace System.

The evaluation team also observed numerous facilities using traffic management tools, such as MIT restrictions and ground stops, without coordinating with the National Command Center. A member of the evaluation team told us that MIT restrictions imposed by local field traffic managers created a "ripple-effect" of delays due to individual facilities imposing restrictions down the line. For example, if New York imposed a 15 MIT restriction, then the flights passing through to Cleveland would be restricted to 20 MIT (New York's 15 miles plus the normal 5 miles separation in Cleveland airspace).

### *Although Various Actions Are Underway, Much Work Remains*

As a result of FAA's evaluation, 165 near-term action items were identified to relieve delays, including: (1) limiting locally initiated ground stops to 30 minutes; (2) providing estimates to air carriers of the time a ground stop will end and the cause for the ground stop; and (3) ensuring that local facilities coordinate MIT restrictions through the National Command Center. According to FAA, most of the action items have been implemented. The evaluation also spurred a number of other initiatives that FAA is implementing, such as formulating procedures on how to manage air traffic when inclement weather is forecast, including the recently announced "Spring 2000" action plan.

FAA is also deploying several new traffic management tools, including: the Flight Schedule Monitor, Collaborative Convective Forecast Product, and Departure Spacing Program. Moreover, FAA has established a web site *(www.fly.faa.gov)* that provides consumers real-time information on air carrier delays

**<u>Provisions of Spring 2000 Action Plan</u>**

- FAA and airline staff will hold teleconferences throughout the day to develop plans addressing conditions 2 to 6 hours into the future using standardized weather forecasts.
- FAA is working with the Department of Defense to allow use of restricted military airspace off the East Coast to help speed traffic flows during poor weather.
- FAA and the airlines are working on using low altitude airspace during periods when airspace at normal altitudes is constrained.
- FAA and the airlines will use the same weather information provided by a state-of-the-art forecast tool (Collaborative Convective Forecast Product) when making decisions on how to deal with storms.
- FAA will expand its website to include up-to-the-minute information on weather conditions.

at the Nation's 40 largest airports. The web site is also linked to other information sources, such as the status of the National Airspace System, which shows all the ground delays and stops the FAA has currently enacted across the nation.

FAA also recognizes the need for a common system for tracking delays, cancellations, and their causes. As a result, the agency has been working closely with the major air carriers in developing the Aviation System Performance Metric (ASPM). ASPM, which became operational in April 2000, establishes a uniform set of metrics[53] by which to measure delays occurring at 21 major U.S. airports.[54] Moreover, it uses a combination of data sources, including flight information from existing BTS and FAA systems, as well as weather conditions and runway usage at the 21 airports.

ASPM has a number of advantages over OPSNET. First, ASPM covers all flight segments in tracking delays, including gate departure, taxi-out, en route, taxi-in, and gate arrival, as well as the overall gate-to-gate times. Second, information is obtained electronically (as compared to OPSNET's manual data collection and entry). For the air carrier data, this will involve (in most cases) obtaining data from the Aircraft Communication Addressing and Reporting System (ACARS).[55/56] Third, ASPM provides FAA and the participating air carriers with "next day reports" (via the Internet) of delays occurring at the 21 airports, on selected routes and flights, and within the overall system. Finally, ASPM tracks cancellations (as well as flight delays) which OPNSET does not address.

FAA officials noted that ASPM will initially be used to help identify and track delays and cancellations as well as measure ATC performance. They also noted their intent to eventually include causal information in ASPM, which will be critical in helping FAA and the air carriers identify areas for improvement (e.g., changes in traffic management practices, funding for equipment and airport enhancements, and airspace redesign).

The need for good causal data was recently reinforced by Congress in The Wendell H. Ford Aviation Investment and Reform Act for the 21st Century or

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53 The delay metrics computed by ASPM include: (a) gate departure, (b) taxi-out, (c) airborne, (d) taxi-in, (e) gate arrival, and (f) gate-to-gate or block.

54 The 21 airports are Atlanta, Boston, Cleveland, Cincinnati, Dallas/Ft. Worth, Detroit, Dulles, Newark, Houston, Kennedy, Los Angeles, LaGuardia, Midway, Memphis, Minneapolis, O'Hare, Philadelphia, Phoenix, Seattle, San Francisco, and St. Louis.

55 ACARS is an air/ground satellite communication network that receives data transmissions from an aircraft's onboard computer system, which are then transmitted to the air carrier's host computer. Of the 10 major air carriers, only 3 currently do not use ACARS (although 2 of the 3 are working towards using ACARS over the next few years).

56 ACARS data are also submitted by the air carriers to BTS every month in compliance with Title 14, Code of Federal Regulations, Chapter II, Part 234.4, Reporting on On-Time Performance.

AIR-21 (Public Law 106-181, April 5, 2000). This Act directs the Secretary of Transportation to modify existing regulations governing the air carrier data submissions to BTS ". . . to disclose more fully to the public the nature and source of delays and cancellations experienced by air travelers." The Act also requires the establishment of a task force (including officials of FAA, airlines, and consumer groups) to develop criteria for obtaining causal information on flight delays and cancellations.

### *Conclusion*

*Notwithstanding recent efforts, much work remains to be done—especially in the area of causal data—if delays and cancellations are to be addressed in a meaningful way.* A good starting point is the development of a uniform system through which all components of DOT and the air carriers will be able to track flight delays and cancellations as well as measure ATC performance. In addition to this system, the aviation community needs to reach agreement on a common set of causal categories, as required by AIR-21. Once established, these categories will serve as a basis for obtaining complete and consistent information on the various causes of flight delays and cancellations, not just those currently recorded by FAA or the air carriers. What is feasible in the way of relief, short and long term, can only be addressed with a common language between the air carriers and FAA and an agreed-upon system for tracking the proximate and underlying causes of delays and cancellations from pre-gate departure through all stages of a flight. Finally, the Department needs to reassess the information it provides consumers, especially in the area of departure delays. The current emphasis on gate departure and arrival delays does not reflect the full extent of delays, much of which is occurring on the ground in the form of longer taxi-out times or is being underreported due to expanded flight schedules.

## RECOMMENDATIONS

We recommend that:

1. FAA, in coordination with BTS, DOT's Office of Aviation Enforcement and Proceedings, and air carriers, continue development of a common system for tracking delays, cancellations, and associated causes, such as improving ASPM.

2. FAA ensure future performance plans include one or more measures for assessing ATC performance that are based on ASPM (not OPSNET) data.

3. BTS, in coordination with FAA and DOT's Office of Aviation Enforcement and Proceedings, provide consumers the following information on a monthly basis: (a) major causes of delays and cancellations by airport, (b) routes with high cancellation rates by air carrier, and (c) an improved measure for tracking ground times once the aircraft has departed the gate.[57]

4. BTS, in coordination with FAA and DOT's Office of Aviation Enforcement and Proceedings, report on a quarterly basis the CFDI or a comparable measure to more accurately portray system-wide increases or decreases in travel time.

## MANAGEMENT AND OIG COMMENTS

OIG representatives met with senior officials from FAA, BTS, and DOT's Office of Aviation Enforcement and Proceedings, as well as the Air Transport Association to discuss our draft report findings and recommendations. As appropriate, we have incorporated their comments into the final report. FAA officials cited their progress with the air carriers in developing a common system for tracking delays and cancellations, as well as deploying new traffic management tools (e.g., Flight Schedule Monitor and Departure Spacing Program). They also noted their intent to move away from OPSNET as a basis for measuring future ATC performance. Likewise, BTS officials noted plans to include additional delay-related information on their website. Overall, DOT officials agreed with the recommendations and have initiated and/or have planned actions aimed at improving the tracking systems used to collect and report on flight delays, cancellations, and associated causes. We agree with these actions and see them as being responsive to our recommendations.

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[57] Some possible options for measuring ground times include: (a) average taxi-out times during peak and non-peak hours of operation by airport, and (b) the rate of significant taxi-out times of 1 hour or greater by air carrier and airport. These alternative measures would be more helpful to consumers than reporting (per existing regulation) an aircraft departure as occurring on time simply because it backed away from the gate as scheduled only to sit on the runway for several hours.

## OBJECTIVES, SCOPE AND METHODOLOGY, AND PRIOR AUDIT COVERAGE

### OBJECTIVE

The Chairman of the Subcommittee on Transportation and Related Agencies, Senate Committee on Appropriations, asked us to examine the sources and causes of flight delays and cancellations. Due to the high complexity of this issue and the large differences in the systems used for tracking delays, cancellations, and associated causes, we focused the audit on determining the strengths and weaknesses of the various systems as well as the overall amount of delay occurring in the National Airspace System. Specifically, we examined the systems used by the Department of Transportation's (DOT) Bureau of Transportation Statistics (BTS) and Federal Aviation Administration (FAA), as well as the major air carriers.

### SCOPE AND METHODOLOGY

During this audit, we met with and obtained data from officials within DOT, including General Counsel's Office of Aviation Enforcement and Proceedings; BTS' Office of Airline Information; and FAA's Office of Air Traffic Services, Office of Airport Planning and Programming, Office of System Capacity, and the Air Traffic Control System Command Center, Herndon, Virginia. In addition, we obtained information and data from the 10 largest air carriers,[1] the Air Transport Association of North America, the Regional Airline Association, The Mitre Corporation, and the Logistics Management Institute. We also interviewed representatives from Government and industry unions, including the National Air Traffic Controllers Association, the Professional Airways System Specialists, and the Air Line Pilots Association. Table A-1 lists the FAA facilities and air carriers we visited during this audit.

**Table A-1: Sites Visited During Audit**

| | |
|---|---|
| **AIRPORT TOWERS** | Atlanta Hartsfield<br>Chicago O'Hare<br>Dallas/Ft. Worth<br>Newark International<br>New York's John F. Kennedy<br>New York's LaGuardia<br>Washington Dulles |
| **TERMINAL RADAR APPROACH CONTROL (TRACON) FACILITIES** | Atlanta Hartsfield<br>Dallas/Ft. Worth<br>New York<br>Washington Dulles |
| **AIR ROUTE TRAFFIC CONTROL CENTERS (ARTCC)** | Atlanta<br>Chicago<br>Ft. Worth<br>New York |
| **FAA REGIONAL OFFICES** | Eastern Region<br>Great Lakes Region<br>Southern Region<br>Southwest Region |
| **AIR CARRIERS** | Alaska Airlines<br>American Airlines<br>Continental Airlines<br>Delta Air Lines<br>Southwest<br>United Airlines |

[1] The 10 reporting air carriers are: Alaska Airlines, America West Airlines, American Airlines, Continental Airlines, Delta Air Lines, Northwest Airlines, Southwest Airlines, Trans World Airlines, United Airlines, and U.S. Airways.

**OBJECTIVES, SCOPE AND METHODOLOGY, AND PRIOR AUDIT COVERAGE (CONTINUED)**

To determine the extent of airline delays and cancellations, we analyzed: (1) air carrier data collected by BTS from 1988 through 1999; (2) OPSNET data collected by FAA on an airport-by-airport basis for the same time period; and (3) Aviation Data Systems flight records for three major New York area airports from 1997 to 1999. In addition to calculating the frequencies and rates of delays and cancellations, we analyzed these data for changes in air carriers' scheduled flight times, including ground and air times, for routes that account for 87 percent of all scheduled domestic passenger flights. Finally, we examined changes in average hourly taxi-out and taxi-in times for the 28 largest airports from 1995 through 1999.

To determine how FAA, BTS, and air carriers define, collect, and categorize data on flight delays and cancellations, we obtained data from and documentation on FAA's OPSNET and BTS' on-time performance data system. We also held discussions with FAA and BTS officials on their systems/definitions of "delay," and the protocols and procedures they used to collect and categorize these data. We held similar discussions with officials from the 10 largest air carriers, and obtained limited information from their internal data systems on delays and cancellations.

To identify the differences in how FAA and BTS calculate and record delays, we tracked a total of 1,690 scheduled flights between Atlanta, Chicago, Dallas-Fort Worth, and Newark, from November 1 through 5, 1999. We obtained FAA's data on these flights from FAA's Air Traffic Control Systems Command Center in Herndon, Virginia. To calculate the BTS-defined delays, we obtained information from the air carriers for these same flights.

To determine the cost of delays and cancellations, we asked the 10 largest air carriers to provide an estimate of their direct operating costs per minute of delay and per cancellation. (See Exhibit B for our methodology for estimating the cost of delays and cancellations for the air carriers.) To further illustrate the effect of delays on the flying public, we calculated a Consumer Flight Delay Indicator (CFDI) based on average delays per flight, which we applied to each of the 28 major airports. (See Exhibit C for a more detailed discussion on our calculation of the CFDI for the overall system as well as individual airports.)

To determine the factors that contribute to delays and cancellations, we analyzed causal data from FAA and the largest air carriers. In addition, we held discussions with officials within FAA and representatives from the air carriers, unions, and industry trade

## OBJECTIVES, SCOPE AND METHODOLOGY, AND PRIOR AUDIT COVERAGE (CONTINUED)

associations, on what they viewed as the major causes of, and factors contributing to, delays and cancellations. We compared National Weather Service significant meteorological events (SIGMET) to delays and cancellations reported by FAA and BTS, as well as 1999 SIGMETs to those issued in prior years. We also discussed airport and airspace capacity issues with FAA and obtained forecasts on enplanements and flight operations through 2015, as well as acquiring projections on the use of regional jets from the Regional Airline Association. To examine the impact of air carrier scheduling practices on delays, we obtained departure and arrival information from FAA and the Official Airline Guide for six major airports. We also reviewed several initiatives taken or being taken by FAA, including the self-evaluation (which led to the "Spring 2000" Action Plan) and the Aviation System Performance Metric.

This audit was conducted from September 1999 to June 2000 in compliance with Government Auditing Standards prescribed by the Comptroller General of the United States, with the exception of independently verifying the reliability of all computer-based data used in our analyses. Because of the large amount of data and varying sources from which it was derived, we were unable to test all data sets within our time and resource constraints. In many cases, the data were accepted as being current and consistent (e.g., National Weather Service and air carrier causal data), or recognized as possessing limitations (e.g., FAA's OPSNET data).

### PRIOR AUDIT COVERAGE

We have issued three prior reports related to weaknesses in procedures for collecting and analyzing data on delays and their causes. Among other things, we pointed out that uniform and accurate information on the number of delays occurring and the causes for those delays is necessary for identifying and prioritizing capacity enhancement plans, and providing consumers with accurate on-time performance information. Following are synopses of the three reports.

In 1987, we issued our report, Audit of Airport and Airspace Capacity (AV-FA-7-031, August 25, 1987), which addressed the procedures and practices FAA used to record, report, and analyze air traffic delays. We found that different methods were used at FAA air traffic facilities to record and analyze delays, and that there was no assurance that all delays were being reported. Further, we found that FAA had not developed definitive criteria for identifying and reporting the causes of delays. We concluded that an improved system for collecting and analyzing delays and their causes would help FAA

**OBJECTIVES, SCOPE AND METHODOLOGY, AND PRIOR AUDIT COVERAGE (CONTINUED)**

identify systemic airport and airspace causes and thereby provide an objective basis for developing solutions to reduce delays. Therefore, we recommended that FAA revise its delay reporting system to improve and standardize procedures for recording and analyzing delay data by: (1) providing more specific definitions of delay causes, (2) including criteria for assigning each delay to a specific cause, and (3) improving requirements for documenting the procedures for reporting. We also recommended that FAA establish a system to periodically review its delay reporting system for accuracy and consistency with procedures, and to establish a system to analyze delay data and use the results to identify and prioritize capacity enhancement projects. In response to the report findings and recommendations (which were accepted), FAA established OPSNET.

In our Audit of Air Carrier Arrival Data (FE-1998-103, March 30, 1998), we reported on the inconsistencies in how the major air carriers reported arrival times to DOT to fulfill their on-time reporting requirements. We recommended that BTS establish a common definition of gate arrival and require all air carriers to report accordingly. We also recommended that DOT's Office of Aviation Enforcement and Proceedings include information in the Air Travel Consumer Report indicating whether air carriers use an automated or manual system to record their arrival times. Both recommendations were accepted, with BTS establishing "setting aircraft parking brakes" as the common measure for determining gate arrival and DOT's Office of Aviation Enforcement and Proceedings including a statement in its monthly report noting which air carriers had automated or manual recording systems.

In February 1999, we reported on the methodologies and systems air carriers used to report departure times and the accuracy of the resulting data (Audit of Air Carrier Departure Data, CE-1999-054, February 5, 1999). We found that the air carriers were using four different methods for reporting departure times and that two air carriers may be reporting inaccurate information. Moreover, based on our analysis of air carrier data submissions to BTS, we determined that gate-to-gate flight times had increased on most domestic routes and an increasing number of flights were departing earlier than scheduled. We recommended that BTS establish a common definition of gate departure and require all air carriers to report accordingly, and work with those air carriers with manual data collection systems to ensure accurate reporting of their departure data. We also recommended that DOT's Office of Aviation Enforcement and Proceedings take action to ensure consumers are notified of those flights that regularly depart 11 minutes

**OBJECTIVES, SCOPE AND METHODOLOGY, AND PRIOR AUDIT COVERAGE (CONTINUED)**

or more early. Both recommendations were accepted, with BTS establishing "releasing aircraft parking brakes" as the common measure for determining gate departure and notifying the 10 largest air carriers of the importance of accurate reporting. Starting mid-2000, DOT's Office of Aviation Enforcement and Proceedings plans to include information on early departing flights in the monthly Air Travel Consumer Report.

## METHODOLOGY USED TO ESTIMATE THE COST OF DELAYS AND CANCELLATIONS

To determine the cost of delays to air carriers from 1995 through 1999, we asked the 10 largest air carriers to provide an estimate of their direct operating costs per minute of delay. Five of the air carriers[2] reported direct operating costs of delays ranging from $23 to $50 per minute in 1999, depending on the size and model of aircraft being used. We used the mean of this range ($36.50 per minute) as our base cost estimate for 1999, and adjusted it for inflation[3] for the preceding 4 years. We then multiplied the average cost per minute by the total scheduled (i.e., increase in scheduled flight times since 1988)[4] and unscheduled arrival delay minutes. Results are shown in Table B-1.

**Table B-1: Calculating the Estimated Average Direct Operating Costs of Scheduled and Unscheduled Delays, 1995–1999**

| Year | Total Scheduled & Unscheduled Delay Minutes (a) | Mean Direct Operating Cost per Minute (b) | Estimated Total Annual Costs |
|---|---|---|---|
| 1999 | 89,977,323 | $36.50 | $3,284,172,290 |
| 1998 | 78,062,939 | $35.51 | $2,772,014,964 |
| 1997 | 72,093,298 | $34.95 | $2,519,660,765 |
| 1996 | 77,591,786 | $34.35 | $2,665,277,849 |
| 1995 | 60,571,351 | $33.22 | $2,012,180,280 |
| **Total:** | | | $13,253,306,148 |

(a) Source: BTS data on gate arrival delays of 1 minute or more.
(b) Source: Five air carriers

To estimate the cost of cancellations, we again asked the 10 largest air carriers to provide estimates of their direct operating cost per cancellation. However, seven of the air carriers either had not calculated such an estimate or were hesitant to provide such an estimate. Air carrier representatives explained that beyond the direct cost of paying flight crews and shuffling aircraft around, there are a variety of other costs that may, or may not come into play, such as: lost revenues, paying for passengers' hotel rooms/meals, fare reimbursements, payments to other air carriers to take stranded passengers, and other "unquantifiable" factors such as future lost business/revenue.

Three of the air carriers estimated their costs per canceled flight ranged between $3,500 and $6,684 for 1999. After adjusting for inflation, we calculated an average cost for all canceled flights for each year, 1995 through 1999 (see Table B-2).

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2 The other five air carriers did not provide or track per minute cost of delays.

3 We used the inflation rates published in the Department of Labor's Consumer Price Index (CPI-U).

4 As discussed earlier in the report, air carriers tend to increase their scheduled flight times to absorb anticipated delays in the system and ensure respectable on-time performance statistics. These "scheduled delays" also increase air carriers' costs.

## METHODOLOGY USED TO ESTIMATE THE COST OF DELAYS AND CANCELLATIONS (CONTINUED)

**Table B-2: Calculating the Estimated Average Cost of Cancellations, 1995-1999**

| Year | No. of Canceled Flights (a) | Low Estimated Cost (b) | High Estimated Cost (b) | Total Low Estimate | Total High Estimate | Average Cost of Cancellations |
|---|---|---|---|---|---|---|
| 1999 | 154,311 | $3,499.83 | $6,684.23 | $540,062,267 | $1,031,450,216 | $785,756,242 |
| 1998 | 144,509 | $3,405.33 | $6,508.50 | $492,100,833 | $940,536,827 | $716,318,830 |
| 1997 | 97,763 | $3,350.85 | $6,406.00 | $327,589,149 | $626,269,778 | $476,929,464 |
| 1996 | 128,536 | $3,293.88 | $6,297.10 | $423,382,160 | $809,404,046 | $616,393,103 |
| 1995 | 91,905 | $3,185.19 | $6,089.29 | $292,734,887 | $559,636,197 | $426,185,542 |
| **Total:** | | | | $2,075,869,296 | $3,967,297,064 | $3,021,583,181 |

(a) Source: BTS
(b) Source: Three air carriers

Table B-3 lists, for each of the 28 major airports, total cost of delays and cancellations and total cost of delays and cancellations per commercial flight operation in 1999.

**Table B-3: Estimated Average Cost of Delays and Cancellations by Airport in 1999**

| Major Arrival Airports | Total Costs | Costs Per Operation | Major Arrival Airports | Total Costs | Costs Per Operation |
|---|---|---|---|---|---|
| O'Hare, IL (ORD) | $298,567,158 | $1,074 | Pittsburgh, PA (PIT) | $84,833,432 | $918 |
| Atlanta, GA (ATL) | $250,900,420 | $1,006 | Houston, TX (IAH) | $84,437,911 | $746 |
| Dallas/Ft. Worth (DFW) | $202,345,721 | $878 | Las Vegas, NV (LAS) | $83,503,273 | $761 |
| Los Angeles, CA (LAX) | $153,199,896 | $846 | Seattle, WA (SEA) | $72,752,889 | $754 |
| Newark, NJ (EWR) | $136,212,168 | $1,223 | Denver, CO (DEN) | $70,735,922 | $540 |
| Phoenix, AZ (PHX) | $135,416,637 | $814 | Washington, DC (DCA) | $60,501,735 | $811 |
| Detroit, MI (DTW) | $129,888,647 | $951 | Miami, FL (MIA) | $59,409,317 | $958 |
| Philadelphia, PA (PHL) | $129,847,622 | $1,287 | Orlando, FL (MCO) | $55,298,412 | $691 |
| San Francisco, CA (SFO) | $107,276,346 | $830 | Cincinnati, OH (CVG) | $54,693,396 | $890 |
| St. Louis, MO (STL) | $106,832,403 | $662 | Baltimore, MD (BWI) | $46,886,723 | $781 |
| Minneapolis, MN (MSP) | $106,479,872 | $824 | Salt Lake City, UT (SLC) | $42,943,048 | $554 |
| Boston, MA (BOS) | $106,719,796 | $1,124 | San Diego, CA (SAN) | $37,853,611 | $625 |
| LaGuardia, NY (LGA) | $106,181,201 | $1,173 | Kennedy, NY (JFK) | $34,328,067 | $814 |
| Charlotte, NC (CLT) | $89,829,451 | $880 | Portland, OR (PDX) | $24,497,080 | $482 |
| Total: | | | | $2,903,698,318 | $887 |

## METHODOLOGY USED TO CALCULATE THE CONSUMER FLIGHT DELAY INDICATOR (CFDI) AND RESULTS

In an effort to measure the true growth in passenger travel time, taking into account both scheduled and unscheduled delays, we developed the CFDI. This indicator is based on an aggregation of the total delay minutes (scheduled and unscheduled) per flight operation, as derived from BTS data.[5] Table C-1 illustrates how the annual CFDI rate was calculated for 1995 through 1999. For instance, to determine the total amount of scheduled arrival delay minutes, we multiplied the number of flights (column a) by the average increase in scheduled flight times (column b) for each year. We then added the resulting figure (column c) to the amount of unscheduled arrival delay minutes (column d) to determine total delay minutes (column e). The total delay minutes were then divided by the number of flights (column a) to derive the CFDI rate for each year (column f).

**Table C-1: Annual CFDI Rates for 1995 through 1999 (BTS Data)**

| Year | Number of Flights Reported by 10 Carriers (a) | Avg. Increases in Actual Scheduled Flight Times, 1988-1999 (minutes)* (b) | Total "Scheduled" Arrival Delay (minutes) (c) | Total "Unscheduled" Arrival Delays (minutes) (d) | Total Delay (minutes) (e) | CFDI Rate (min/flight)* (f) |
|---|---|---|---|---|---|---|
| 1995 | 5,327,291 | 1.12 | 5,966,566 | 54,604,785 | 60,571,351 | 11.4 |
| 1996 | 5,351,983 | 2.02 | 10,811,006 | 66,780,780 | 77,591,786 | 14.5 |
| 1997 | 5,411,843 | 2.44 | 13,204,897 | 58,888,401 | 72,093,298 | 13.3 |
| 1998 | 5,384,721 | 2.99 | 16,100,316 | 61,962,623 | 78,062,939 | 14.5 |
| 1999 | 5,527,884 | 4.09 | 22,609,046 | 67,368,277 | 89,977,323 | 16.3 |
| Total/Average: | 27,003,722 | N/A | 68,691,830 | 309,604,866 | 378,296,696 | 14.0 |

* Times are listed in minute increments (e.g., 2.75 is equivalent to 2 minutes and 45 seconds).

This methodology was then applied to each of the 28 major airports to derive an individual airport CFDI rate for 1999. As Table C-2 indicates, the resulting rates varied significantly among the airports, with Philadelphia (PHL) having the highest rate, 27.4 minutes, and Portland (PDX) the lowest, 10.7 minutes, per flight operation.

[5] Calculations of "average increases in actual scheduled flight times" (Tables C-1 and C-2) involved weighted averages with all routes (city-pairs) held constant from 1988 to 1999.

## METHODOLOGY USED TO CALCULATE THE CFDI AND RESULTS (CONTINUED)

### Table C-2: CFDI Rates for the 28 Major Airports, 1999 (BTS Data)

| Arrival Airport | No. of 1999 Flights Reported by 10 Carriers (a) | Avg. Changes in Actual Block Times, 1988-1999 (minutes)* (b) | Total "Scheduled" Arrival Delay (minutes) (c) | Total "Unscheduled" Arrival Delays (minutes) (d) | Total Delay (minutes) (e) | CFDI Rate (min/flight) * (f) |
|---|---|---|---|---|---|---|
| Philadelphia, PA (PHL) | 100,760 | 7.86 | 791,974 | 1,972,673 | 2,764,647 | 27.4 |
| Newark, NJ (EWR) | 110,959 | 7.71 | 855,494 | 2,072,224 | 2,927,718 | 26.4 |
| Atlanta, GA (ATL) | 248,550 | 9.57 | 2,378,624 | 3,538,477 | 5,917,101 | 23.8 |
| LaGuardia, NY (LGA) | 90,600 | 6.57 | 595,242 | 1,550,167 | 2,145,409 | 23.7 |
| Miami, FL (MIA) | 61,905 | 5.49 | 339,858 | 1,014,778 | 1,354,636 | 21.9 |
| Boston, MA (BOS) | 94,902 | 6.43 | 610,220 | 1,440,292 | 2,050,512 | 21.6 |
| O'Hare, IL (ORD) | 276,266 | 4.62 | 1,276,349 | 4,673,543 | 5,949,892 | 21.5 |
| Detroit, MI (DTW) | 136,465 | 5.17 | 705,524 | 2,215,519 | 2,921,043 | 21.4 |
| Phoenix, AZ (PHX) | 166,184 | 4.91 | 815,963 | 2,524,247 | 3,340,210 | 20.1 |
| Cincinnati, OH (CVG) | 60,956 | 6.78 | 413,282 | 808,663 | 1,221,945 | 20.1 |
| Dallas/Ft. Worth, TX (DFW) | 229,345 | 6.23 | 1,428,819 | 3,117,001 | 4,545,820 | 19.8 |
| Pittsburgh, PA (PIT) | 91,980 | 4.45 | 409,311 | 1,376,114 | 1,785,425 | 19.4 |
| Las Vegas, NV (LAS) | 110,708 | 3.48 | 385,264 | 1,722,253 | 2,107,517 | 19.0 |
| Minneapolis, MN (MSP) | 128,925 | 5.24 | 675,567 | 1,755,087 | 2,430,654 | 18.9 |
| Los Angeles, CA (LAX) | 181,251 | 6.09 | 1,103,819 | 2,312,893 | 3,416,712 | 18.9 |
| Kennedy, NY (JFK) | 41,879 | 3.88 | 162,491 | 623,848 | 786,339 | 18.8 |
| Charlotte, NC (CLT) | 101,826 | 3.66 | 372,683 | 1,463,822 | 1,836,505 | 18.0 |
| Houston, TX (IAH) | 112,523 | 4.29 | 482,724 | 1,541,165 | 2,023,889 | 18.0 |
| Baltimore, MD (BWI) | 59,829 | 0.65 | 38,889 | 1,004,470 | 1,043,359 | 17.4 |
| Seattle, WA (SEA) | 96,580 | 3.86 | 372,799 | 1,305,283 | 1,678,082 | 17.4 |
| San Francisco, CA (SFO) | 129,344 | 2.98 | 385,445 | 1,826,798 | 2,212,243 | 17.1 |
| Orlando, FL (MCO) | 80,231 | 2.44 | 195,764 | 1,074,146 | 1,269,910 | 15.8 |
| St. Louis, MO (STL) | 160,253 | 2.39 | 383,005 | 2,041,264 | 2,424,269 | 15.1 |
| San Diego, CA (SAN) | 60,601 | 2.25 | 136,352 | 733,045 | 869,397 | 14.4 |
| Washington, DC (DCA) | 74,483 | 3.01 | 224,194 | 828,064 | 1,052,258 | 14.1 |
| Salt Lake City, UT (SLC) | 77,436 | 3.57 | 276,447 | 729,736 | 1,006,183 | 13.0 |
| Denver, CO (DEN) | 131,086 | 0.35 | 45,880 | 1,556,435 | 1,602,315 | 12.2 |
| Portland, OR (PDX) | 51,874 | -0.11 | -5,706 | 560,649 | 554,943 | 10.7 |
| Total/Average: | 3,267,701 | 4.85 | 15,848,350 | 47,382,656 | 63,231,006 | 19.4 |

* Times are listed in minute increments (e.g., 2.75 is equivalent to 2 minutes and 45 seconds).

## OPSNET DELAYS FOR 28 MAJOR AIRPORTS, 1995 AND 1999

**Table D-1: Number of OPSNET Delays and Percent Change, 1995 and 1999**

| Airport | 1995 | 1999 | % Change |
|---|---|---|---|
| Philadelphia, PA (PHL) | 2,836 | 14,516 | 411.85% |
| Las Vegas, NV (LAS) | 814 | 3,870 | 375.43% |
| Cincinnati, OH (CVG) | 1,780 | 8,376 | 370.56% |
| Seattle, WA (SEA) | 1,807 | 7,982 | 341.73% |
| Phoenix, AZ (PHX) | 2,862 | 11,919 | 316.46% |
| Newark, NJ (EWR) | 14,420 | 36,553 | 153.49% |
| LaGuardia, NY (LGA) | 11,691 | 28,474 | 143.55% |
| Houston, TX (IAH) | 4,128 | 9,524 | 130.72% |
| Kennedy, NY (JFK) | 6,191 | 13,547 | 118.82% |
| Detroit, MI (DTW) | 5,349 | 11,522 | 115.40% |
| Baltimore, MD (BWI) | 770 | 1,573 | 104.29% |
| Minneapolis, MN (MSP) | 4,322 | 8,801 | 103.63% |
| Orlando, FL (MCO) | 1,229 | 2,306 | 87.63% |
| Atlanta, GA (ATL) | 18,471 | 32,737 | 77.23% |
| O’Hare, IL (ORD) | 27,797 | 49,202 | 77.00% |
| Boston, MA (BOS) | 10,597 | 14,989 | 41.45% |
| Washington, DC (DCA) | 1,764 | 2,197 | 24.55% |
| Portland, OR (PDX) | 446 | 469 | 5.16% |
| San Francisco, CA (SFO) | 23,843 | 21,187 | -11.14% |
| San Diego, CA (SAN) | 1,002 | 840 | -16.17% |
| Dallas/Ft. Worth, TX (DFW) | 23,611 | 16,731 | -29.14% |
| Pittsburgh, PA (PIT) | 1,342 | 946 | -29.51% |
| Miami, FL (MIA) | 6,336 | 4,256 | -32.83% |
| Denver, CO (DEN) | 1,901 | 1,254 | -34.03% |
| Salt Lake City, UT (SLC) | 1,125 | 718 | -36.18% |
| Charlotte, NC (CLT) | 2,210 | 1,277 | -42.22% |
| St. Louis, MO (STL) | 17,552 | 9,631 | -45.13% |
| Los Angeles, CA (LAX) | 19,979 | 10,646 | -46.71% |
| Total/Average: | 216,175 | 326,043 | 50.82% |

## OPSNET DELAYS FOR 28 MAJOR AIRPORTS, 1995 AND 1999 (CONTINUED)

### Table D-2: Average Duration of OPSNET Delays and Percent Change, 1995 and 1999

| Airport | 1995* | 1999* | % Change |
|---|---|---|---|
| Salt Lake City, UT (SLC) | 25.36 | 48.70 | 92.03% |
| Washington, DC (DCA) | 32.08 | 53.18 | 65.77% |
| Portland, OR (PDX) | 24.85 | 39.98 | 60.89% |
| San Francisco, CA (SFO) | 35.62 | 52.96 | 48.68% |
| Baltimore, MD (BWI) | 49.17 | 70.08 | 42.53% |
| Denver, CO (DEN) | 30.62 | 43.24 | 41.21% |
| Atlanta, GA (ATL) | 28.87 | 37.67 | 30.48% |
| Philadelphia, PA (PHL) | 35.44 | 45.25 | 27.68% |
| LaGuardia, NY (LGA) | 31.32 | 39.95 | 27.55% |
| Charlotte, NC (CLT) | 32.02 | 40.61 | 26.83% |
| St. Louis, MO (STL) | 38.39 | 48.12 | 25.35% |
| San Diego, CA (SAN) | 35.47 | 43.91 | 23.79% |
| Orlando, FL (MCO) | 38.35 | 46.62 | 21.56% |
| O’Hare, IL (ORD) | 47.30 | 55.83 | 18.03% |
| Dallas/Ft. Worth, TX (DFW) | 34.18 | 38.70 | 13.22% |
| Pittsburgh, PA (PIT) | 40.72 | 45.61 | 12.01% |
| Seattle, WA (SEA) | 28.38 | 31.02 | 9.30% |
| Newark, NJ (EWR) | 45.73 | 49.98 | 9.29% |
| Las Vegas, NV (LAS) | 24.08 | 25.42 | 5.56% |
| Los Angeles, CA (LAX) | 36.10 | 37.79 | 4.68% |
| Cincinnati, OH (CVG) | 30.96 | 31.89 | 3.00% |
| Boston, MA (BOS) | 42.84 | 43.96 | 2.61% |
| Phoenix, AZ (PHX) | 27.25 | 27.11 | -0.51% |
| Kennedy, NY (JFK) | 37.98 | 36.44 | -4.05% |
| Detroit, MI (DTW) | 37.93 | 36.16 | -4.67% |
| Miami, FL (MIA) | 31.79 | 30.02 | -5.57% |
| Minneapolis, MN (MSP) | 36.71 | 33.10 | -9.83% |
| Houston, TX (IAH) | 36.61 | 32.74 | -10.57% |

* Times are listed in minute increments (e.g., 2.75 is equivalent to 2 minutes and 45 seconds).

## BTS DEPARTURE AND ARRIVAL DELAYS FOR 28 MAJOR AIRPORTS, 1997 AND 1999

### Table E-1: Number of Late Departures and Arrivals and Percent Change, 1997 and 1999

| Airport | Late Departures 1997 | Late Departures 1999 | Late Departures % Change | Late Arrivals 1997 | Late Arrivals 1999 | Late Arrivals % Change |
|---|---|---|---|---|---|---|
| Baltimore, MD (BWI) | 9,041 | 18,569 | 105.39% | 11,320 | 19,129 | 68.98% |
| LaGuardia, NY (LGA) | 13,907 | 22,048 | 58.54% | 23,161 | 32,530 | 40.45% |
| Philadelphia, PA (PHL) | 19,812 | 32,890 | 66.01% | 28,372 | 39,078 | 37.73% |
| Phoenix, AZ (PHX) | 31,518 | 42,727 | 35.56% | 37,499 | 50,875 | 35.67% |
| O'Hare, IL (ORD) | 59,237 | 74,463 | 25.70% | 71,843 | 92,801 | 29.17% |
| Boston, MA (BOS) | 16,593 | 24,069 | 45.06% | 23,480 | 29,983 | 27.70% |
| Las Vegas, NV (LAS) | 21,337 | 29,608 | 38.76% | 26,347 | 33,528 | 27.26% |
| Pittsburgh, PA (PIT) | 17,040 | 23,566 | 38.30% | 22,729 | 28,583 | 25.76% |
| Seattle, WA (SEA) | 17,312 | 23,311 | 34.65% | 22,224 | 27,664 | 24.48% |
| Miami, FL (MIA) | 11,184 | 14,698 | 31.42% | 14,831 | 17,776 | 19.86% |
| Orlando, FL (MCO) | 12,947 | 16,617 | 28.35% | 15,870 | 18,874 | 18.93% |
| San Diego, CA (SAN) | 10,244 | 12,811 | 25.06% | 12,422 | 14,247 | 14.69% |
| Houston, TX (IAH) | 18,438 | 21,836 | 18.43% | 24,361 | 27,790 | 14.08% |
| Kennedy, NY (JFK) | 7,102 | 7,548 | 6.28% | 9,800 | 11,162 | 13.90% |
| Washington, DC (DCA) | 11,538 | 14,606 | 26.59% | 16,616 | 18,705 | 12.57% |
| Charlotte, NC (CLT) | 21,013 | 27,047 | 28.72% | 27,663 | 31,114 | 12.48% |
| Los Angeles, CA (LAX) | 39,775 | 40,440 | 1.67% | 46,689 | 49,284 | 5.56% |
| Newark, NJ (EWR) | 25,768 | 30,288 | 17.54% | 36,139 | 37,897 | 4.86% |
| Dallas/Ft. Worth, TX (DFW) | 48,703 | 49,751 | 2.15% | 57,960 | 60,668 | 4.67% |
| Atlanta, GA (ATL) | 55,570 | 57,111 | 2.77% | 69,645 | 72,232 | 3.71% |
| St. Louis, MO (STL) | 32,295 | 34,650 | 7.29% | 37,358 | 37,074 | -0.76% |
| Detroit, MI (DTW) | 39,274 | 32,262 | -17.85% | 44,994 | 42,984 | -4.47% |
| Minneapolis, MN (MSP) | 29,214 | 25,368 | -13.16% | 36,926 | 34,897 | -5.49% |
| San Francisco, CA (SFO) | 29,565 | 29,642 | 0.26% | 37,689 | 35,294 | -6.35% |
| Portland, OR (PDX) | 9,042 | 8,709 | -3.68% | 11,414 | 10,580 | -7.31% |
| Denver, CO (DEN) | 24,388 | 22,257 | -8.74% | 33,039 | 29,810 | -9.77% |
| Cincinnati, OH (CVG) | 13,110 | 11,162 | -14.86% | 20,610 | 16,499 | -19.95% |
| Salt Lake City, UT (SLC) | 15,046 | 11,635 | -22.67% | 21,130 | 14,286 | -32.39% |
| Total: | 660,013 | 759,689 | 15.10% | 842,131 | 935,344 | 11.07% |

## CHANGE IN ACTUAL GATE-TO-GATE TIMES FOR FLIGHTS DEPARTING FROM THE 28 MAJOR AIRPORTS, 1988 TO 1999 AND 1995 TO 1999 (BTS DATA)

| Departure Airport | No. of City Pair Routes Analyzed | Number of 1999 Flights | Change from 1995 to 1999 | | | Average Change "Gate-to-Gate" Times 1995-1999* | Average Change "Gate-to-Gate" Times 1988-1999* |
|---|---|---|---|---|---|---|---|
| | | | Taxi-Out Time* | En Route Flight Time* | Taxi-In Time* | | |
| Newark, NJ (EWR) | 44 | 114,548 | 6.23 | -1.04 | 0.27 | 5.47 | 9.00 |
| LaGuardia, NY (LGA) | 39 | 91,545 | 7.67 | -0.11 | 0.64 | 8.20 | 8.62 |
| Philadelphia, PA (PHL) | 52 | 105,472 | 6.03 | -0.21 | 0.54 | 6.36 | 7.93 |
| Kennedy, NY (JFK) | 27 | 42,924 | 4.67 | -0.56 | 0.88 | 4.99 | 7.28 |
| Miami, FL (MIA) | 34 | 63,096 | -0.46 | 0.44 | 0.79 | 0.76 | 7.20 |
| Boston, MA (BOS) | 38 | 99,210 | 4.17 | 0.63 | 0.61 | 5.42 | 7.16 |
| Atlanta, GA (ATL) | 90 | 253,084 | 1.59 | 0.52 | 1.00 | 3.10 | 6.83 |
| Detroit, MI (DTW) | 73 | 143,520 | 2.57 | 0.50 | 0.66 | 3.74 | 6.64 |
| Cincinnati, OH (CVG) | 61 | 74,408 | 3.66 | 0.95 | 1.30 | 5.91 | 6.50 |
| Minneapolis, MN (MSP) | 86 | 138,764 | 2.50 | 0.44 | 0.37 | 3.31 | 5.90 |
| Dallas/Ft. Worth, TX (DFW) | 83 | 232,381 | 0.08 | 1.62 | 0.70 | 2.40 | 5.31 |
| Salt Lake City, UH (SLC) | 43 | 77,577 | 0.34 | 1.02 | 0.94 | 2.31 | 4.75 |
| Phoenix, AZ (PHX) | 49 | 168,993 | 2.69 | 0.73 | 0.57 | 4.00 | 4.51 |
| Houston, TX (IAH) | 59 | 121,418 | 3.01 | -0.06 | 0.52 | 3.48 | 4.50 |
| Pittsburgh, PA (PIT) | 67 | 96,840 | 0.97 | 0.37 | 0.63 | 1.97 | 4.20 |
| Las Vegas, NV (LAS) | 48 | 119,150 | 2.25 | 0.51 | 0.45 | 3.21 | 4.09 |
| Seattle, WA (SEA) | 41 | 99,715 | 0.80 | 0.43 | 0.41 | 1.64 | 3.70 |
| Washington, DC (DCA) | 41 | 77,653 | 2.25 | 0.37 | 0.84 | 3.46 | 3.63 |
| Orlando, FL (MCO) | 42 | 87,189 | 0.32 | 0.95 | 0.68 | 1.94 | 3.49 |
| O'Hare, IL (ORD) | 93 | 280,968 | 3.41 | 0.47 | 0.60 | 4.48 | 3.29 |
| Charlotte, NC (CLT) | 68 | 115,810 | 0.81 | 0.66 | 0.41 | 1.88 | 3.01 |
| San Francisco, CA (SFO) | 44 | 130,588 | 0.89 | 1.20 | 0.58 | 2.67 | 2.59 |
| Portland, OR (PDX) | 28 | 54,424 | 0.59 | 0.21 | 0.43 | 1.23 | 2.36 |
| Los Angeles, CA (LAX) | 46 | 183,690 | 0.99 | 1.21 | 0.35 | 2.55 | 2.25 |
| St. Louis, MO (STL) | 73 | 169,560 | -1.17 | -0.14 | 0.33 | -0.98 | 2.03 |
| San Diego, CA (SAN) | 28 | 65,309 | 0.84 | 0.86 | 0.45 | 2.14 | 1.31 |
| Denver, CO (DEN) | 64 | 133,076 | 0.43 | 0.74 | 0.56 | 1.73 | -0.89 |
| Baltimore, MD (BWI) | 35 | 69,205 | 0.54 | -0.77 | 0.31 | 0.07 | -1.68 |
| Total/Average: | 1,496 | 3,410,117 | 2.02 | 0.51 | 0.60 | 3.12 | 4.48 |

* Times are listed in minute increments (e.g., 2.75 is equivalent to 2 minutes and 45 seconds).

## NUMBER OF SIGNIFICANT TAXI-OUT TIMES (1 HOUR OR MORE) FOR THE 28 MAJOR AIRPORTS AND 10 LARGEST AIR CARRIERS, 1995 AND 1999

### Table G-1: Significant Taxi-Out Times by Airport and Percent Change (BTS Data)

| Airport | 1995 | 1999 | % Change |
|---|---|---|---|
| Philadelphia, PA (PHL) | 386 | 2,370 | 514% |
| Phoenix, AZ (PHX) | 79 | 358 | 353% |
| Orlando, FL (MCO) | 105 | 400 | 281% |
| Boston, MA (BOS) | 280 | 1,028 | 267% |
| Newark, NJ (EWR) | 1,882 | 6,601 | 251% |
| LaGuardia, NY (LGA) | 936 | 3,039 | 225% |
| Las Vegas, NV (LAS) | 77 | 206 | 168% |
| Houston, TX (IAH) | 361 | 951 | 163% |
| Chicago, IL (ORD) | 2,101 | 5,385 | 156% |
| Denver, CO (DEN) | 528 | 1,254 | 138% |
| Kennedy, NY (JFK) | 915 | 2,091 | 129% |
| San Francisco, CA (SFO) | 144 | 319 | 122% |
| Atlanta, GA (ATL) | 1,158 | 2,445 | 111% |
| Washington, DC (DCA) | 392 | 806 | 106% |
| Seattle, WA (SEA) | 43 | 88 | 105% |
| Minneapolis, MN (MSP) | 951 | 1,890 | 99% |
| Detroit, MI (DTW) | 1,185 | 2,307 | 95% |
| Baltimore, MD (BWI) | 152 | 292 | 92% |
| Los Angeles, CA (LAX) | 263 | 467 | 78% |
| Pittsburgh, PA (PIT) | 394 | 678 | 72% |
| Portland, OR (PDX) | 19 | 30 | 58% |
| Cincinnati, OH (CVG) | 318 | 502 | 58% |
| Salt Lake City, UT (SLC) | 170 | 240 | 41% |
| Miami, FL (MIA) | 496 | 683 | 38% |
| St. Louis, MO (STL) | 946 | 1,299 | 37% |
| San Diego, CA (SAN) | 73 | 97 | 33% |
| Dallas, TX (DFW) | 2,460 | 3,246 | 32% |
| Charlotte, NC (CLT) | 350 | 451 | 29% |
| Total: | 17,164 | 39,523 | 130% |

## NUMBER OF SIGNIFICANT TAXI-OUT TIMES (1 HOUR OR MORE) FOR THE 28 MAJOR AIRPORTS AND 10 LARGEST AIR CARRIERS, 1995 AND 1999 (CONTINUED)

**Table G-2: Significant Taxi-Out Times by Air Carrier and Percent Change (BTS Data)**

| Air Carrier | 1995 | 1999 | % Change |
|---|---|---|---|
| America West | 133 | 631 | 374% |
| Continental | 2,003 | 7,006 | 250% |
| United | 2,297 | 6,164 | 168% |
| US Airways | 1,591 | 4,247 | 167% |
| Delta | 2,624 | 6,069 | 131% |
| Northwest | 2,176 | 4,385 | 102% |
| Southwest | 173 | 335 | 94% |
| American | 4,739 | 8,559 | 81% |
| Alaska | 14 | 22 | 57% |
| Trans World | 1,414 | 2,105 | 49% |
| Total: | 17,164 | 39,523 | 130% |

**EXHIBIT H**
(Page 1 of 1)

## TOTAL SCHEDULED AND UNSCHEDULED ARRIVAL DELAY MINUTES FOR 28 MAJOR AIRPORTS, 1999 (BTS DATA)

| Airports | Scheduled Delays (minutes) | % Represented by Scheduled Delays | Unscheduled Delays (minutes) | % Represented by Unscheduled Delays | Total Delay (minutes) |
|---|---|---|---|---|---|
| Chicago, IL (ORD) | 1,276,349 | 21.45% | 4,673,543 | 78.55% | 5,949,892 |
| Atlanta, GA (ATL) | 2,378,624 | 40.20% | 3,538,477 | 59.80% | 5,917,101 |
| Dallas, TX (DFW) | 1,428,819 | 31.43% | 3,117,001 | 68.57% | 4,545,820 |
| Los Angeles, CA (LAX) | 1,103,819 | 32.31% | 2,312,893 | 67.69% | 3,416,712 |
| Phoenix, AZ (PHX) | 815,963 | 24.43% | 2,524,247 | 75.57% | 3,340,210 |
| Newark, NJ (EWR) | 855,494 | 29.22% | 2,072,224 | 70.78% | 2,927,718 |
| Detroit, MI (DTW) | 705,524 | 24.15% | 2,215,519 | 75.85% | 2,921,043 |
| Philadelphia, PA (PHL) | 791,974 | 28.65% | 1,972,673 | 71.35% | 2,764,647 |
| Minneapolis, MN (MSP) | 675,567 | 27.79% | 1,755,087 | 72.21% | 2,430,654 |
| St. Louis, MO (STL) | 383,005 | 15.80% | 2,041,264 | 84.20% | 2,424,269 |
| San Francisco, CA (SFO) | 385,445 | 17.42% | 1,826,798 | 82.58% | 2,212,243 |
| LaGuardia, NY (LGA) | 595,242 | 27.74% | 1,550,167 | 72.26% | 2,145,409 |
| Las Vegas, NV (LAS) | 385,264 | 18.28% | 1,722,253 | 81.72% | 2,107,517 |
| Boston, MA (BOS) | 610,220 | 29.76% | 1,440,292 | 70.24% | 2,050,512 |
| Houston, TX (IAH) | 482,724 | 23.85% | 1,541,165 | 76.15% | 2,023,889 |
| Charlotte, NC (CLT) | 372,683 | 20.29% | 1,463,822 | 79.71% | 1,836,505 |
| Pittsburgh, PA (PIT) | 409,311 | 22.93% | 1,376,114 | 77.07% | 1,785,425 |
| Seattle, WA (SEA) | 372,799 | 22.22% | 1,305,283 | 77.78% | 1,678,082 |
| Denver, CO (DEN) | 45,880 | 2.86% | 1,556,435 | 97.14% | 1,602,315 |
| Miami, FL (MIA) | 339,858 | 25.09% | 1,014,778 | 74.91% | 1,354,636 |
| Orlando, FL (MCO) | 195,764 | 15.42% | 1,074,146 | 84.58% | 1,269,910 |
| Cincinnati, OH (CVG) | 413,282 | 33.82% | 808,663 | 66.18% | 1,221,945 |
| Washington, DC (DCA) | 224,194 | 21.31% | 828,064 | 78.69% | 1,052,258 |
| Baltimore, MD (BWI) | 38,889 | 3.73% | 1,004,470 | 96.27% | 1,043,359 |
| Salt Lake City, UT (SLC) | 276,447 | 27.47% | 729,736 | 72.53% | 1,006,183 |
| San Diego, CA (SAN) | 136,352 | 15.68% | 733,045 | 84.32% | 869,397 |
| Kennedy, NY (JFK) | 162,491 | 20.66% | 623,848 | 79.34% | 786,339 |
| Portland, OR (PDX) | -5,706 | -1.03% | 560,649 | 101.03% | 554,943 |
| Total: | 15,848,350 | 25.06% | 47,382,656 | 74.94% | 63,231,006 |

## FLIGHT CANCELLATIONS FOR 28 MAJOR AIRPORTS AND 10 LARGEST AIR CARRIERS, 1995 AND 1999

**Table I-1: Flight Cancellations by Airport and Percent Change (BTS Data)**

| Airport | No. of Flights Canceled 1995 | No. of Flights Canceled 1999 | % Change |
|---|---|---|---|
| Philadelphia, PA (PHL) | 1,775 | 5,683 | 220.17% |
| Charlotte, NC (CLT) | 1,708 | 4,477 | 162.12% |
| O'Hare, IL (ORD) | 6,188 | 15,985 | 158.32% |
| Atlanta, GA (ATL) | 2,887 | 6,859 | 137.58% |
| Orlando, FL (MCO) | 741 | 1,757 | 137.11% |
| LaGuardia, NY (LGA) | 2,415 | 5,474 | 126.67% |
| Seattle, WA (SEA) | 1,015 | 2,259 | 122.56% |
| Boston, MA (BOS) | 2,900 | 6,260 | 115.86% |
| Miami, FL (MIA) | 933 | 1,957 | 109.75% |
| San Francisco, CA (SFO) | 2,606 | 5,210 | 99.92% |
| Baltimore, MD (BWI) | 897 | 1,729 | 92.75% |
| Portland, OR (PDX) | 443 | 833 | 88.04% |
| Newark, NJ (EWR) | 3,194 | 5,764 | 80.46% |
| Washington, DC (DCA) | 2,466 | 4,339 | 75.95% |
| Pittsburgh, PA (PIT) | 2,214 | 3,862 | 74.44% |
| Denver, CO (DEN) | 1,382 | 2,406 | 74.10% |
| Dallas/Ft. Worth, TX (DFW) | 4,466 | 7,153 | 60.17% |
| Phoenix, AZ (PHX) | 1,695 | 2,651 | 56.40% |
| Los Angeles, CA (LAX) | 3,747 | 5,595 | 49.32% |
| Salt Lake City, UT (SLC) | 828 | 1,221 | 47.46% |
| Kennedy, NY (JFK) | 775 | 1,105 | 42.58% |
| Houston, TX (IAH) | 1,462 | 2,075 | 41.93% |
| San Diego, CA (SAN) | 856 | 1,202 | 40.42% |
| Cincinnati, OH (CVG) | 1,412 | 1,982 | 40.37% |
| Detroit, MI (DTW) | 3,900 | 4,570 | 17.18% |
| Las Vegas, NV (LAS) | 1,206 | 1,292 | 7.13% |
| Minneapolis, MN (MSP) | 3,463 | 3,488 | 0.72% |
| St. Louis, MO (STL) | 4,145 | 3,603 | -13.08% |
| Total: | 61,719 | 110,791 | 79.51% |

## FLIGHT CANCELLATIONS FOR 28 MAJOR AIRPORTS AND 10 LARGEST AIR CARRIERS, 1995 AND 1999 (CONTINUED)

### Table I-2: Flight Cancellations by Air Carrier and Percent Change (BTS Data)

| Air Carriers | No. of Flights Canceled 1995 | No. of Flights Canceled 1999 | Percent Change 1995-1999 |
|---|---|---|---|
| Alaska | 1,928 | 5,364 | 178.22% |
| American | 11,295 | 28,960 | 156.40% |
| US Airways | 13,898 | 32,309 | 132.47% |
| United | 13,326 | 27,359 | 105.31% |
| Delta | 12,090 | 21,743 | 79.84% |
| America West | 3,030 | 5,162 | 70.36% |
| Northwest | 13,112 | 12,505 | -4.63% |
| Continental | 8,755 | 8,294 | -5.27% |
| Southwest | 8,140 | 7,606 | -6.56% |
| Trans World | 6,331 | 5,009 | -20.88% |
| Total: | 91,905 | 154,311 | 67.90% |

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