Travel Behavior of U.S. Domestic Airline Passengers and Its Impacts on Infrastructure Utilization

Final report

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Executive Summary

Unexpected and unannounced delays and cancellations of flights have emerged as a quasi-normal phenomenon in recent months and years. The airline unreliability has become unbearable day by day. The volume of airline passengers on domestic routes in the United States has risen despite the devastating terrorist acts of September 11, 2001 while the level of service has gone down in recent years. Some speculate that this increased ridership has caused extra pressure on available infrastructure such as airports. This study investigates the nature of domestic air passenger travel demand at the airports. It also investigates the level of service provided at the airports that are explained by different measuring units. The study includes five regional airports: Chicago's O'Hare International Airport (ORD), Detroit Metropolitan Wayne County International Airport (DTW), Cincinnati-Covington International Airport (CVG), Cleveland Hopkins International Airport (CLE), and Toledo Express Airport (TOL). It finds that ORD, as it stands for the last decade, has been consistently providing unsatisfactory services to the passengers in terms of flight delays (both departure and arrival), luggage handling, passenger complaints, involuntary denial of boarding, etc. However, four other regional airports are doing better than ORD in providing services to the passengers. The report recommends that ORD expand its infrastructure including adding runways, increasing gates, and increasing number of seats for passengers waiting for flights.

Keywords: Air Travel; Travel Behavior; Passenger Volume; Infrastructure

Subject Category: *Function(s)*: Research; Education & Training. *Mode(s)*: Aviation

1 Introduction

It is evident from the Bureau of Transportation Statistics (BTS) that there has been a steady increase in the number of flight operations in the last decade, from over 5 million in 1995 to almost 7.5 million in 2007 (see Table 1: Summary of Airline On-Time Performance through December, 2007) (BTS, 2008). As there has been a continuous rise in operations, there has also been a decline in the percent of on-time arrivals. Curiously, in the year following the attacks on September 11th, 2001, the airline industry had its best performance, albeit with its lowest number of operations prior to 1995. Furthermore, the table indicates an overall and general increase in the following performance categories with the exception of 2002: late arrivals, late departures, cancelled flights, diverted flights, percent of late arrivals, percent of late departures, percent cancelled, and percent diverted. With a few minor exceptions, the trend is obvious: flights and volume are on the rise, while performance and efficiency of the industry is struggling to keep pace.

Some industry experts and analysts have discussed the divergent perceptions of the two main aircraft manufacturers, U.S. made Boeing and European consortium Airbus (Wei & Hansen, 2007). In formulating their business plan and strategic approach toward future industry trends, Boeing has indicated that in order to accommodate the projected air travel growth, airlines will likely be offering more frequent flights. Thus, according to Boeing's forecasts (2005), smaller, more fuel efficient, single-aisle aircrafts will dominate the world air travel market. It has responded accordingly with the introduction of its 7E7 Dreamliner aircraft line, a family of 200- to 300-passenger planes intended for

Table 1: Summary of Airline On-Time Performance Year-to-date through December 2007										
Year-to-date numbers for all years										
Year	**Operations**	**Late Arrivals**	**Late Departures**	**Cancelled**	**Diverted**	**% On-time Arrivals**	**% Late Arrivals**	**% Late Departures**	**% Cancelled**	**% Diverted**
1995	5,327,435	1,039,250	827,934	91,905	10,492	78.57	19.51	15.54	1.73	0.20
1996	5,351,983	1,220,045	973,948	128,536	14,121	74.54	22.80	18.20	2.40	0.26
1997	5,411,843	1,083,834	846,870	97,763	12,081	77.94	20.03	15.65	1.81	0.22
1998	5,384,721	1,070,071	870,395	144,509	13,161	77.20	19.87	16.16	2.68	0.24
1999	5,527,884	1,152,725	937,273	154,311	13,555	76.11	20.85	16.96	2.79	0.25
2000	5,683,047	1,356,040	1,131,663	187,490	14,254	72.59	23.86	19.91	3.30	0.25
2001	5,967,780	1,104,439	953,808	231,198	12,909	77.40	18.51	15.98	3.87	0.22
2002	5,271,359	868,225	717,368	65,143	8,356	82.14	16.47	13.61	1.24	0.16
2003	6,488,540	1,057,804	834,390	101,469	11,381	81.96	16.30	12.86	1.56	0.18
2004	7,129,270	1,421,391	1,187,594	127,757	13,784	78.08	19.94	16.66	1.79	0.19
2005	7,140,596	1,466,065	1,279,404	133,730	14,028	77.40	20.53	17.92	1.87	0.20
2006	7,141,922	1,615,537	1,424,777	121,934	16,186	75.45	22.62	19.95	1.71	0.23
2007	7,453,215	1,803,320	1,572,335	160,748	17,179	73.42	24.20	21.10	2.16	0.23
SOURCE: Bureau of Transportation Statistics, Airline On-Time Data										

routes ranging from 3,500 to 8,500 nautical miles and reportedly 20% more fuel efficient than comparable sized airplanes. Moreover, Boeing discarded its 2002 plans for the introduction of the 747X, a bulked up version of its large 747 jumbo jet line. Conversely, Airbus's (2005) equivalent market forecast report suggests that the future of air travel will be lead by much larger aircraft. It too has responded with the introduction of its A380, a 525-seat, twin-aisle aircraft. Obviously, both airplane manufacturers see an increase in future world wide air travel demand, but are taking markedly different business approaches and attitudes toward travelers' and airports' expectations and capabilities.

The aviation industry was devastated by the terrorist acts of September 11th, 2001, and the safety precautions of airport administrations have changed significantly since then (Bhadra & Texter, 2004; Wei & Hansen, 2007). While this is a certainty, the future of the industry as a whole looks rather uncertain for various reasons. Recently, fuel costs had hit an all-time record high, which has cut into the profit margins of airlines. Also, while airport capacity is fixed,

domestic passenger travel demand is at its highest level ever, according to recent reports out of the Bureau of Transportation Statistics. Likewise, US carriers transported 3.1% more domestic passengers (677 million passengers on 10,317 departures) and 4.6% more international passengers during the first 11 months of 2007 than the same period for 2006 (BTS, 2008). Low-fare carrier Southwest Airlines was the biggest domestic transporter, while American Airlines carried more international passengers than any other domestic airline. This increased passenger travel demand trend is expected to continue for several years.

On another note, airlines have been demanding airport runway expansion in order to off-set the rise in passenger demand and reduce congestion and flight delays. This is often a tricky demand, as runway improvements and expansions are costly and typically encounter NIMBY-like resistance from environmentalists and local land and homeowners who already bear the burden of noisy jets landing and taking off just above their homes. Currently, though, as Wei and Hansen (2007) note, most airline operations at some major airports utilize low capacity planes, i.e., fewer than 150 seats. The prevalence and duration of flight delays are significantly greater on routes where only one airline provides direct service, and that additional competition is correlated with better on-time performance (Mazzeo, 2003).

Obviously, the airline industry is facing numerous challenges and will continue to regroup and reorganize in the post-9/11 world. Barring any future terrorist activity or major airplane disaster, the air passenger travel demand should continue to grow (Mazzeo, 2003; Bhadra & Texter, 2004; Wei & Hansen, 2007; BTS, 2008); however, rising fuel costs, a sluggish economy, airport capacity and runway congestion, along with cost and service cutting measures and labor/union struggles will also plague this industry. An important but untested area of research involves airline level of service (LOS) at specific airports and in the largest US markets.

In brief, the above explanation reveals that the volume of airline passengers has risen despite the reduction in LOS provided by the commercial airlines on domestic US routes. Unexpected and unannounced delays and cancellations of flights have emerged as a more frequent phenomenon in recent years than in the past. The airline unreliability is becoming unbearable day by day. The friendly skies are rather bumpy these days. Interestingly, this poorer service has not reduced the demand by the air passengers. Even the September 11, 2001 incident did not have any apparent negative effects on the air travel demand. This study focuses on the in- and out-bound domestic flights in the airports of this region (see Map 1): Chicago O'Hare International Airport (ORD), Detroit Metropolitan Wayne County International Airport (DTW), Cincinnati-Covington International Airport (CVG), Cleveland Hopkins International Airport (CLE), and Toledo Express Airport (TOL).

2 Objectives of the Study

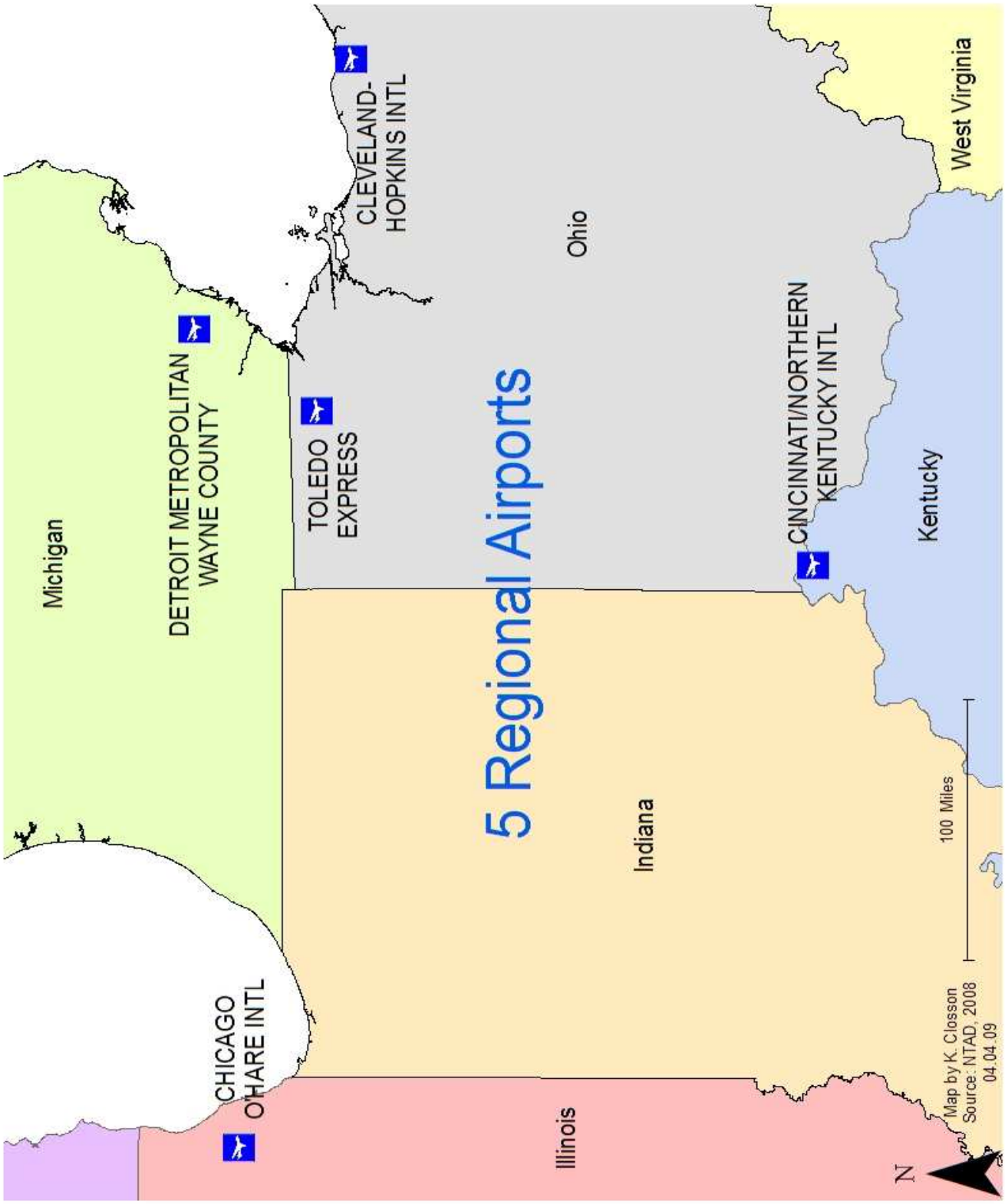
The objectives of the study were as below:

i) To investigate the nature and causes of travel demand increase/change by the airline passengers on the domestic routes in last decade.

ii) To develop time series trend lines (longitudinal trends) that represent the travel demand in last decade.

iii) To investigate and explore whether the travel demand by the airline passengers has crossed the threshold air infrastructure utilization level.

Map 1: Geographic Locations of Five Regional Airports



3 Review of Literature

In this brief literature review, several articles are cited; however, it is important to note that much of this topic is largely uncharted territory. Most of the data consulted in this review originated from the Bureau of Transportation Statistics (BTS, 2008). Other important studies to date include an analysis of flight delays on specific routes served only by one airline carrier (Mazzeo, 2003), selection of aircraft size and service frequency in select markets (Wei & Hansen, 2007), and an econometric framework analysis of domestic airline networks from 1995 – 2003 (Bhadra & Texter, 2004). Adrangi, et. al., (2001) attempted to provide a measurement model in their examination of the time series structure of air transportation demand. Finally, two other studies worth mentioning for their possible replication in the US involve LOS measurements at airport passenger terminals/departure lounges in Rio de Janeiro, Brazil, (Correia & Wirasinghe, 2008; Correia, et. al., 2008).

Correia, et. al. (2008) and Correia and Wirasinghe (2008) are concerned with LOS measurements at Sao Paulo's Guarulhos International Airport in Brazil. Both studies utilized a survey instrument and conducted passenger interviews inside the aforementioned airport. Both papers incorporate psychometric scaling techniques pioneered by Bock and Jones (1968) and their results and findings could prove useful to other large, international airports.

In Correia, et. al. (2008), the authors focus on LOS measures and objective variables and how they can be applied to the planning and design stages of airport terminals. This study asked questions relating to the following measures: curbside components; check-in counter experiences; security screening processes; and departure lounge facilities and experiences. In a second survey at the same airport the study conducted pilot surveys on: walking distance, total service time, actual walking (minimum) distance, and tardity-differential or facility orientation.

While the authors acknowledged the complexity of this type of research, they suggested that these LOS measurements could be applied to other Brazilian or international airport facilities.

In Correia and Wirasinghe (2008), however, the main focus was not on the greater airport experiences as in the previous study, but rather on the specific analysis of LOS measures at airport departure lounges inside the Guarulhos International Airport. As the departure lounge is one of the most important features to air travelers, this study emphasizes the following kinds of attribute measurements: availability of seats; space available for circulation; and waiting time.

Unlike the above-mentioned Brazilian studies, two articles from China examine the broader scope of air passenger travel behavior and patterns in that booming Asian market. Loo (2008) provides insight into the stated preferences (SP) of air travelers departing from Hong Kong International Airport (HKIA) while Jin, et. al. (2004) provide a longitudinal analysis of Chinese air passenger transportation patterns from 1980–1998. The former utilizes a multi-lingual survey instrument issued at HKIA in March, 2003, while the latter gathered data from the Yearbook House of China Transportation and Communication and disregarded cargo data over the same period. Furthermore, Loo's (2008) study found differences in the preferences of short-, medium-, and long-haul HKIA travelers, while Jin, et. al. (2004) discovered interesting patterns in the evolution of China's expanding air travel industry and airport volume and location. Both are regarded as important steps in furthering the geographic understanding of the growing air passenger transportation industry in China.

Gardiner and Ison (2008) identify the primary factors influencing the airport choice of non-integrated cargo airlines within regions. They add to the survey information gathered by Gardiner, et. al. (2005), by interviewing three airlines and three airports. Obviously, this paper's main concern is cargo-related; however, it does provide important insight into the airport

selection of non-integrated air carriers. They mention 15 factors that influence an airline's decision to locate at a certain airport.

Vowles (2006) pays tribute to the work of geographers who have published research on the air transportation industry. He uses several databases and search engines to obtain a list of 176 air transportation-related works written by geographers. Moreover, he divides the publications using three approaches: "historical, publication outlets, and topic focus" (p. 12). He suggests that geographers will continue to make important contributions to the industry and encourages attention to the exploding Asian markets of China, India, and certain Middle Eastern countries.

Wei and Hansen (2005, 2007) contribute two separate but equally important papers. The first is constructed around a nested logit model used to analyze "… the role of aircraft size on airlines' demand and market share in a duopoly competitive environment at the market level, with one major airport in origin and one major airport in destination" (p. 317). After applying filters to air carrier flight data from 1989 to 1998, thirteen specific routes were selected for evaluation. They found that airlines can profit more in the form of market share by service frequency increase compared to aircraft size increase. Furthermore, they conclude that because increased frequency attracts more passengers, airlines are tempted to use smaller aircraft than the least-cost aircrafts. Wei and Hansen (2007) further add to our understanding of airline competition. Specifically, they investigate the decisions on aircraft size and service frequency by applying three game-theoretic models and a sensitivity analysis. Obtaining data from the same source as their previous study, they apply the information to two hypothetical markets: a short-haul market and a long-haul market. Their findings were not surprising to them as they noted in

their aforementioned study how airlines have little to no incentive to use larger planes than the least-cost ones.

Another study that looked at competitiveness is Mazzeo's (2003) review of airlines' on-time performance. Unlike Wei and Hansen (2005, 2007), Mazzeo (2003) makes use of the Airline Information Database provided by the BTS. He then takes into consideration data gathered by the National Weather Service as a measure of control, as airlines frequently cite Mother Nature as a reason for poor on-time performances. After a thorough regression analysis, Mazzeo finds that "… flight delays are more common and longer in duration on routes where only one airline provides direct service and through airports where the carrier represents a larger share of total flights" (p. 276). Essentially, he suggests that lack of competition can lead to lower quality of service and vice versa.

Tierney and Kuby (2008) examine the competitive environment of airline choice by air travelers in multi-airport regions in the US. Unlike other domestic articles, this one gathered data through the use of a survey at Phoenix's Sky Harbor International Airport and collected information from passengers holding tickets on Southwest Airlines and America West Airlines during the spring of 2004. The two multi-airport destination-regions selected were Boston-Providence and Baltimore-Washington, DC. The authors discovered that airfare played a major role (58%) in passengers' decision to use a less convenient (secondary) airport facility; however, other factors related to the secondary airport were also found to be important to consumers, i.e., fewer flight delays, easier ground transportation, and better flight times.

Adrangi et. al. (2001) examine chaos and non-linearity in the demand for US airline industry's services. Using data acquired from Database Products, the authors disaggregated the information into monthly sets of over two decades of air transportation service statistics. Then,

various Generalized Autoregressive Conditional Heteroscdeastic (GARCH) models were applied to three main categories of data: revenue passenger miles, mail revenue ton miles, and freight revenue ton miles. Adrangi et. al. (2001) did find evidence of non-linear dependence through their analysis; however, they could not find consistent results in regard to chaos.

Obviously, the domestic-based research relies on a wide-range of methodologies and sources of data. Only one made use of a survey instrument, while the others collected statistics from an outside (third-party) agency or directly from the FAA or BTS. This seems to indicate how diverse and increasingly important the field of research devoted to this industry can be. Recently, it has become even more important to investigate various LOS and airline/air travel-related topics, as the continual increase in jet fuel price has caused several major (and smaller regional) airlines to revise their services and consider cost cutting measures, i.e., layoffs, reduction of flights and routes, and decreases in airport facility/departure lounge services. The industry is facing unusually expensive operating costs while attempting to remain competitive and profitable.

Three other studies are worth mentioning at this point. The first, by Wei and Hansen (2005), is an off-shoot of their efforts in the realm of aircraft size and seat availability and market share regarding specific routes and markets. Second, Suzuki (2000) investigated, through the use of a new modeling method, the relationship between airline carriers' on-time performance and market share. Lastly, but perhaps most important, is the most recent edition of the Federal Aviation Administration's (FAA) analysis of domestic airports and their forecast for future operating capacity.

Wei and Hansen (2005) laid the foundation for their other study mentioned previously (Wei & Hansen, 2007). Here, they review prior studies and applications of commercial carriers'

Quality of Service Index (QSI). Their focus utilizes the analysis of actual aircraft size on the demand and market share in a duopoly competitive environment at the market level. Unlike previous research, however, they take into account seat availability within these markets, and limit their study to only include jet aircraft and not smaller, regional planes with less than 60 seats. After constructing a nested logit model, Wei and Hansen (2005) concluded that there is an economic advantage for passenger carriers to utilize planes smaller than the "least-cost" aircraft. Furthermore, an increase in flight frequency is more attractive to passengers, while providing higher returns in the airline's market share, since increasing aircraft size is less attractive to flyers. In other words, more flights using smaller planes is better for increasing an airline's market share since larger planes with less frequent flights is an economic disadvantage.

Proposing the use of a new modeling method, Suzuki (2000) essentially analyzes airline performance measures and the likelihood of passengers to switch airlines after experiencing delays. Utilizing Department of Transportation (DOT) data, the author explores the performance of three major carriers – American, Delta, and United Airlines between 1990–1997 from Atlanta's Hartsfield Airport (ATL) to Chicago's O'Hare Airport (ORD), as this is one of the nation's most competitive and voluminous routes. While other airlines served this route periodically during that time frame, Suzuki notes that only the three airlines mentioned above were consistent service providers throughout the study period. In summary, Suzuki concludes that air passengers are more likely to switch carriers after experiencing flight delay(s) than those passengers not experiencing delay.

Finally, the FAA (2007) sponsors an annual review of the nation's busiest airports and attempts to forecast future capacity and issues relating to congestion through to the year 2025. Currently, the study includes 56 domestic airports and their surrounding metropolitan areas. The

study identifies several major airports (and metropolitan areas) in need of short-term capacity additions and suggests future capacity needs at others. Between 2007 and 2015, the FAA has earmarked six major airports to monitor in terms of capacity and future needs: Baltimore-Washington (BWI), Atlanta Hartsfield (ATL), McCarran International (LAS – Las Vegas), Chicago Midway (MDW), San Antonio International (SAT), and San Diego International (SAN). Moreover, the FAA claims that New York City (specifically, LaGuardia [LGA] and Newark International [EWR]) already suffers from a lack of capacity, while Chicago O'Hare (ORD) and Fort Lauderdale-Hollywood International (FLL) were listed in this category as well. Furthermore, the FAA notes that after planned improvements to existing infrastructure, a few airports and metropolitan areas will still need additional capacity; however, the list expands greatly if those capacity needs are not met by 2015. The list swells for the same projections to the year 2025. Put another way, many of the nation's busiest airports (and largest metropolitan areas) will be virtually crippled by a lack of capacity if planned improvements are not met. This survey of the nation's 56 busiest airports is current and suggests quick action for much needed airport infrastructure improvements.

4 Methodology

There are important studies to date that include analysis of flight delays on specific routes served only by one airline carrier (Mazzeo, 2003), selection of aircraft size and service frequency in select markets (Wei & Hansen, 2007), and an econometric framework analysis of domestic airline networks from 1995 – 2003 (Bhadra & Texter, 2004). Also, Adrangi et. al. (2001) attempted to provide a measurement model in their examination of the time series structure of air transportation demand. Two other studies worth mentioning for their possible replication in the

US involve LOS measurements at airport passenger terminals/departure lounges in Rio de Janeiro, Brazil. (Correia & Wirasinghe, 2008; Correia, et. al., 2008).

The studies cited above have followed different technical approaches and methodologies. Among these and other studies, relatively few have researched the nature of air travel demand data. While Adrangi, et. al. (2001) uses GARCH model to explain the behavior of US airline industry's service demand, Mazzeo (2003) uses descriptive statistics and Ordinary Least Squares (OLS) regression models to explain the competition and service quality in US airline industry. Others use survey-based descriptive statistics to analyze overall LOS measures for airport passenger terminals (Correia, et. al., 2008; Correia and Wirasinghe, 2008) and game theories to investigate airlines' competition in aircraft size and service frequency in duopoly markets (Wei and Hansen, 2007)

This study uses descriptive and quantitative statistics to address the objectives. These methodologies help analyze and explain such factors as flight delays and cancellations, capacity of the current airline/airport infrastructure, LOS quality, and such. The study also conducts a longitudinal analysis of the last decade using the BTS dataset.

5 Data Sources

The study uses data mostly from the BTS and The US DOT. The U.S. DOT issues a monthly Air Travel Consumer Report that includes data on the following sub-sections: flight delays, mishandled baggage, oversales, and consumer complaints. However, more recent reports include additional information regarding the following two sub-sections: customer service reports to the Transportation Security Administration, and airline reports of the loss, injury, or death of animals during air transportation. The latter two additional sub-sections were included

in monthly reports starting with the July 2005 edition. It is designed to assist air travelers by providing information on the quality of service (QOS) of domestic air carriers. Each table of statistical information begins with a brief explanation of how to read and understand the tables within each sub-section. Lastly, the information in each monthly report is a collection of data from two months prior to the publication date except for oversells data which is calculated and reported on a quarterly basis.

Flight delay information is divided into the following sub-categories:

- Overall Percentage of Reported Flight Operations Arriving On Time, by Carrier;
- Overall Percentage of Reported Flight Operations Arriving On Time and Carrier Rank, by Month, Quarter, and Data Base to Date;
- Number of Reported Flight Arrivals and Percentage Arriving On Time, by Carrier and Airport;
- Percentage of All Carriers' Reported Flight Operations Arriving On Time, by Airport and Time of Day;
- Percentage of All Carriers' Reported Flight Operations Departing On Time, by Airport and Time of Day;
- List of Regularly Scheduled Flights Arriving Late 80% of the Time or More;
- Number and Percentage of Regularly Scheduled Flights Arriving Late 70% of the Time or More; and
- On-Time Arrival and Departure Percentage, by Airport.

Mishandled baggage information is provided in terms of the rate of mishandled-baggage reports per 1,000 passengers by carrier and for the industry.

Oversells information is presented to include only passengers whose oversold flight departs without them; they do not include passengers affected by cancelled, delayed or diverted flights. These tables give information by carriers on the number of passengers bumped involuntarily and on the number who voluntarily gave up their seats on an oversold flight in exchange for compensation. Also shown in the report is the rate of involuntary denied boardings per 10,000 passengers.

Consumer complaints information is a summary of aviation consumer complaints filed with the DOT in writing, by telephone or in person. The report does not, however, include safety complaints.

Data on departures were obtained from the BTS web-page and the US air carrier traffic statistics section. The information can be gathered in monthly or 12-month tables including the following sub-categories: Revenue Passenger Enplanements, Revenue Passenger Miles, Available Seat Miles, Passenger Load Factor, Revenue Freight Ton Miles, Total Revenue Ton Miles, Available Ton Miles, Ton Mile Load Factor, Revenue Departures Performed, Revenue Aircraft Miles Flown, and Revenue Aircraft Hours (Airborne). Furthermore, each table can be customized according the following filters: Geographic Area (domestic/international/system-wide), Schedule Type (scheduled/non-scheduled/total), Service Class (passenger/cargo), and Date (month/year).

The number of gates, runways, baggage handling carousels, public parking spaces, and airline lounges were gathered from respective airport facility websites. Other information pertaining to individual airlines' maintenance expenditures were obtained from their quarterly financial statements.

6 Results

The results section is divided in two parts. First part portrays a generalized trend of travel behavior and infrastructure utilization for domestic airports and airlines in last decade while second part discusses these issues for five regional airports that are of interests to this study.

6.1 Travel Demand Trend of Passengers and LOS Provided by Domestic Airports and Airlines

The study analyses several variables to get a clear picture of travel demand trend of passengers and LOS provided by the airports and airlines. Those are enplaned passengers, passengers boarded by major airlines, voluntary denied boardings, involuntary denied boardings, mishandles baggage reports, and consumer complaints. Some of these are standardized by certain numbers of passengers like 10,000 or 100,000. These factors are discussed below with the help of tables and figures. The total number of enplaned (domestic only) passengers is listed below in Table 2 and Figure 1.

Table 2: Enplaned passengers (domestic only)

Year	Enplaned Passengers
1998	481,746,769
1999	499,103,518
2000	517,466,576
2001	488,375,272
2002	471,351,588
2003	524,515,038
2004	575,364,288
2005	589,674,652
2006	606,604,432
2007	628,799,697

Figure 1: Enplaned passengers (domestic only)

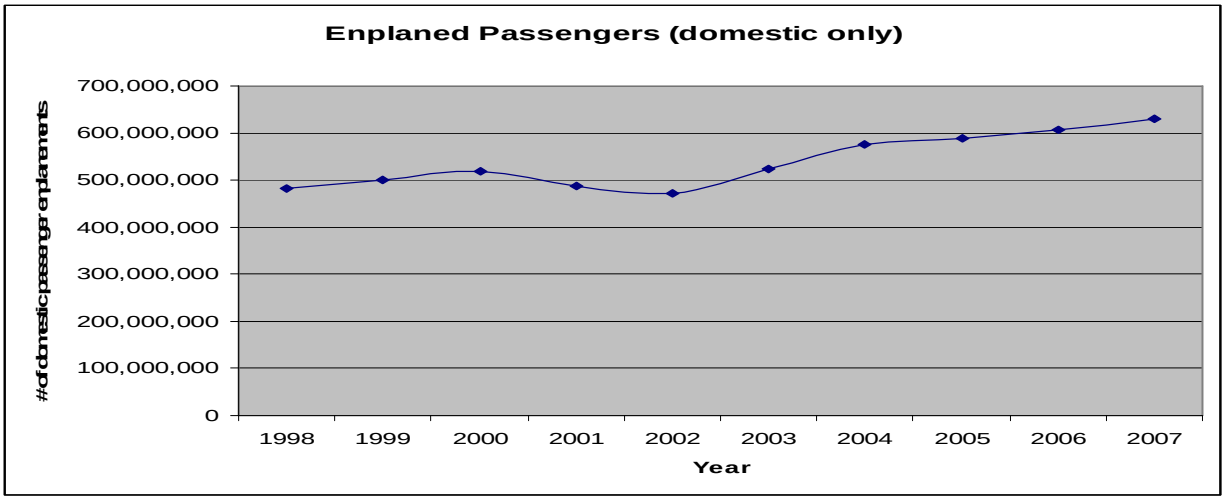


Table 3 and Figure 2 chart the steady increase in ridership on major US airlines since the early 2000's. There has been a steady, albeit slow, increase in the number of passenger boardings since after the September 11th attacks. Industry experts are predicting that this steady increase is likely to continue.

Table 3: Passengers boarded by major U.S. airlines

Year	Passengers Boarded
1997	502,959,759
1998	514,170,050
1999	523,081,442
2000	540,198,168
2001	498,303,935
2002	467,204,981
2003	485,797,269
2004	522,308,320
2005	539,796,221
2006	555,080,498
2007	571,660,914

Figure 2: Passengers boarded by major U.S. airlines

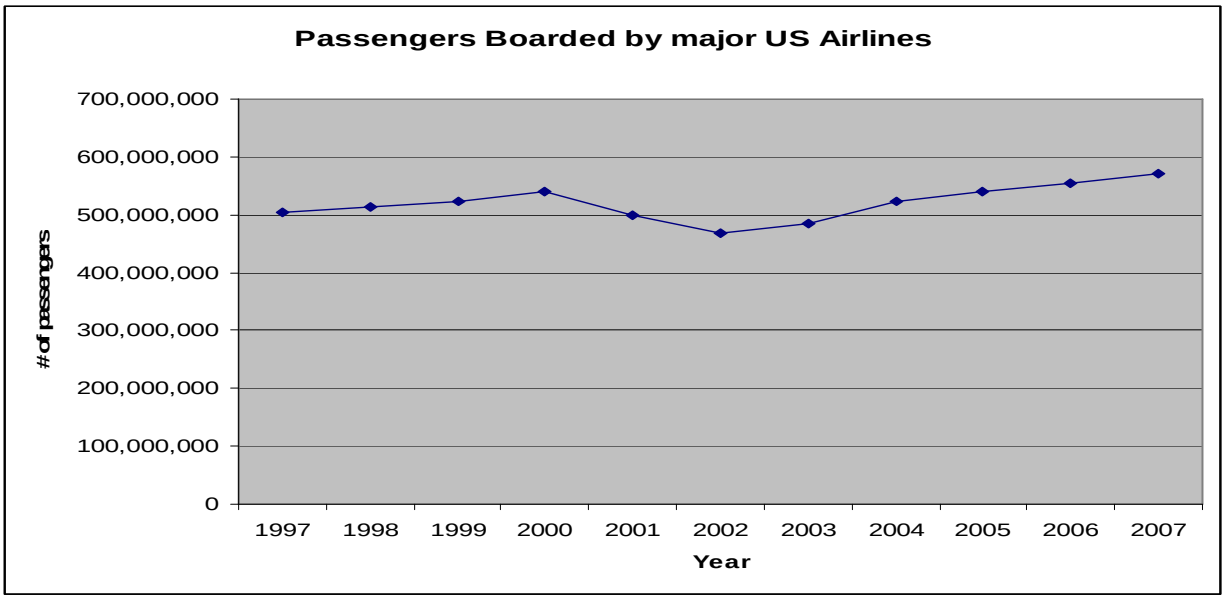
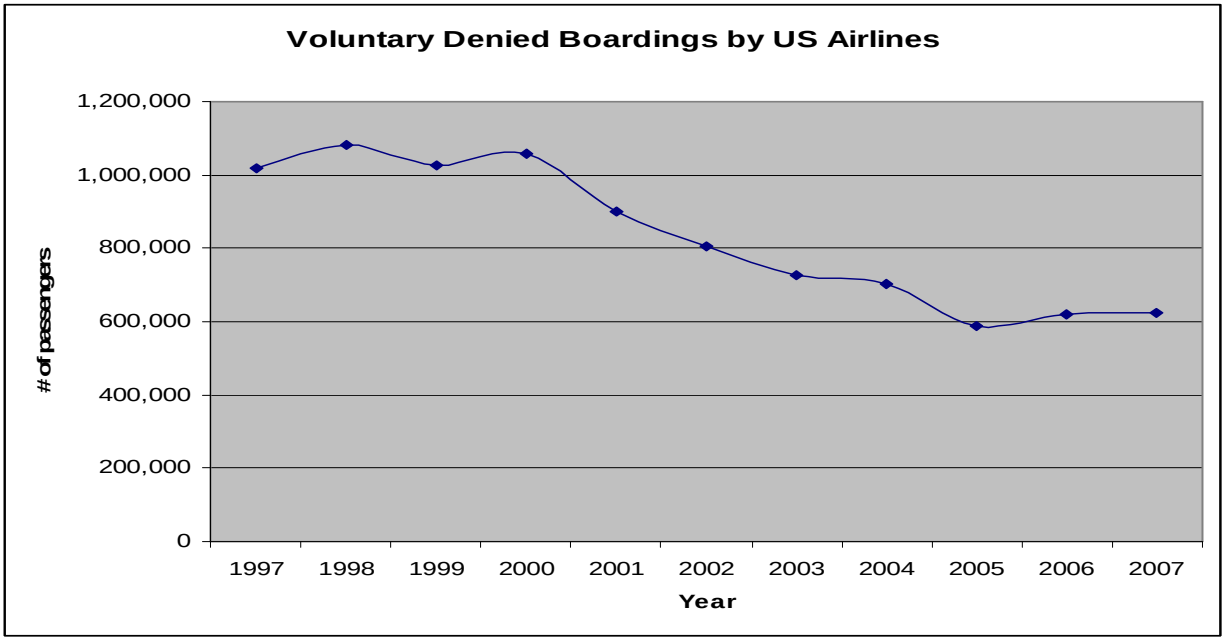


Table 4 and Figure 3 display how voluntary denied boardings have generally gone down since 2000, though 2006 and 2007 have witnessed a slight increase.

Table 4: Voluntary denied boardings by U.S. Airlines

Year	Voluntary Denied Boardings
1997	1,017,926
1998	1,081,204
1999	1,024,439
2000	1,057,395
2001	898,530
2002	803,344
2003	726,860
2004	702,025
2005	588,266
2006	620,580
2007	621,717

Figure 3: Voluntary denied boardings by U.S. Airlines

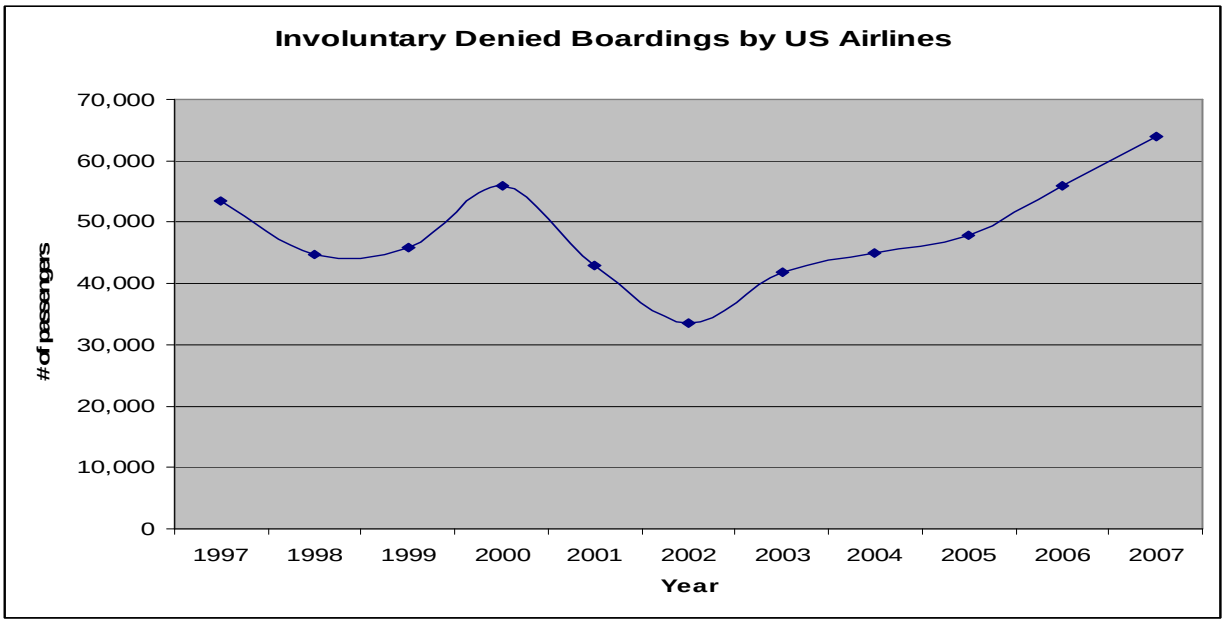


Unlike voluntary denied boardings, involuntary denied boardings have skyrocketed in recent years. The lowest recorded number of involuntary denied boardings occurred in 2002; however, as Table 5 and Figure 4 point out, domestic airlines have increased the amount of over-booked flights every year since 2002.

Table 5: Involuntary denied boardings by U.S. airlines

Year	Involuntary Denied Boardings
1997	53,546
1998	44,797
1999	45,774
2000	56,022
2001	43,000
2002	33,642
2003	41,932
2004	44,900
2005	47,774
2006	55,828
2007	63,878

Figure 4: Involuntary denied boardings by U.S. airlines

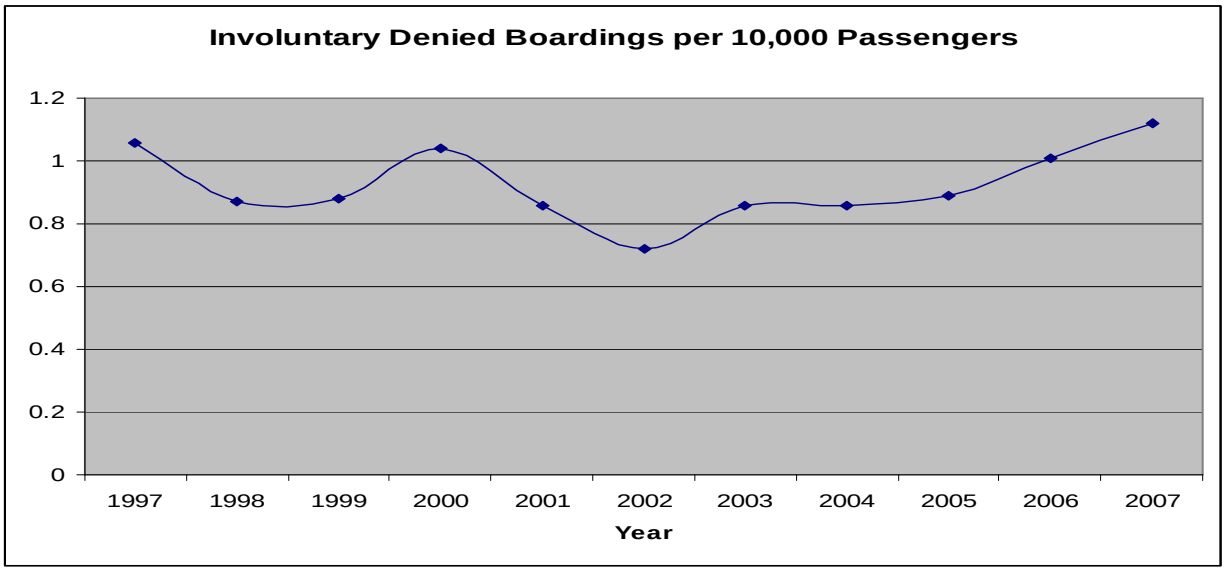


Similar to Table 5 and Figure 4, Table 6 and Figure 5 show the number of denied boardings per 10,000 passengers. There has been an increase in this category since 2002.

Table 6: Involuntary denied boardings per 10,000 passengers

Year	Involuntary Denied Boardings
1997	1.06
1998	0.87
1999	0.88
2000	1.04
2001	0.86
2002	0.72
2003	0.86
2004	0.86
2005	0.89
2006	1.01
2007	1.12

Figure 5: Involuntary denied boardings per 10,000 passengers

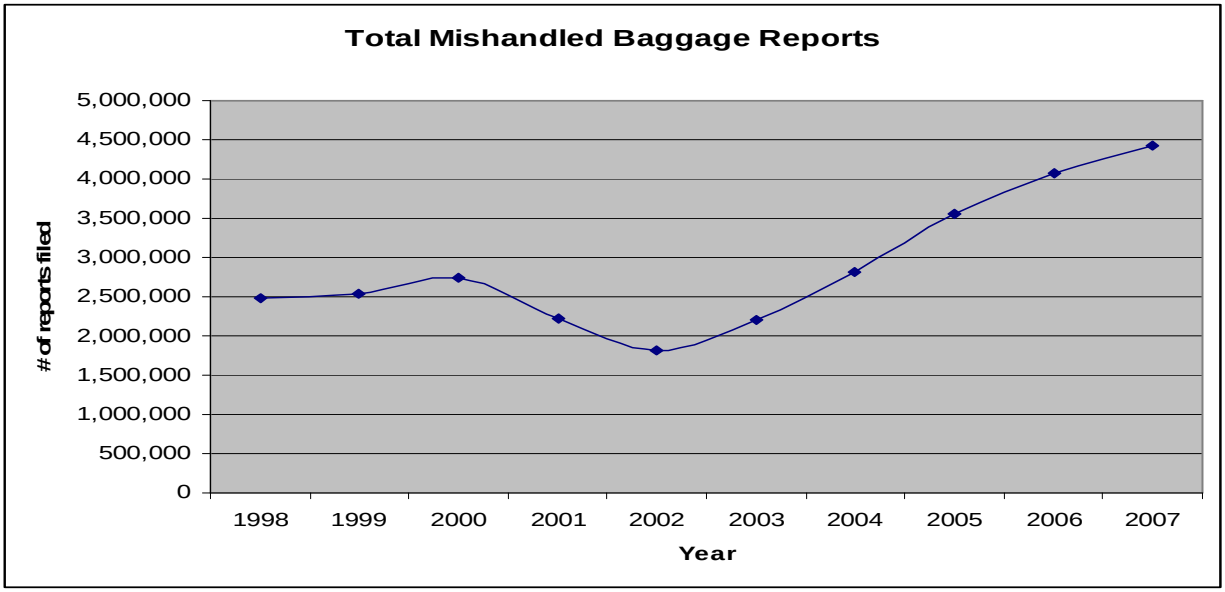


An all too common travel nightmare, 'mishandled baggage' reports have been kept by the FAA since 1998. Like involuntary denied boardings, this trend has been on the rise since its lowest point in 2002. The number of reports filed from 1998 to 2007 is shown in Table 7 and Figure 6.

Table 7: Total mishandled baggage reports

Year	Total Mishandled Baggage Reports
1998	2,484,841
1999	2,537,018
2000	2,738,463
2001	2,221,303
2002	1,808,977
2003	2,198,934
2004	2,822,206
2005	3,562,132
2006	4,083,054
2007	4,419,654

Figure 6: Total mishandled baggage reports



Similar to Table 7 and Figure 6, Table 8 and Figure 7 show the recent rise in mishandled baggage reports per 1,000 passengers. Clearly, this is an increasingly common event. It indicates a decreasing LOS by the airlines.

Table 8: Mishandled baggage reports per 1,000 passengers

Year	Reports per 1,000 Pass
1998	5.16
1999	5.08
2000	5.29
2001	4.55
2002	3.84
2003	4.19
2004	4.91
2005	6.04
2006	6.73
2007	7.03

Figure 7: Mishandled baggage reports per 1,000 passengers

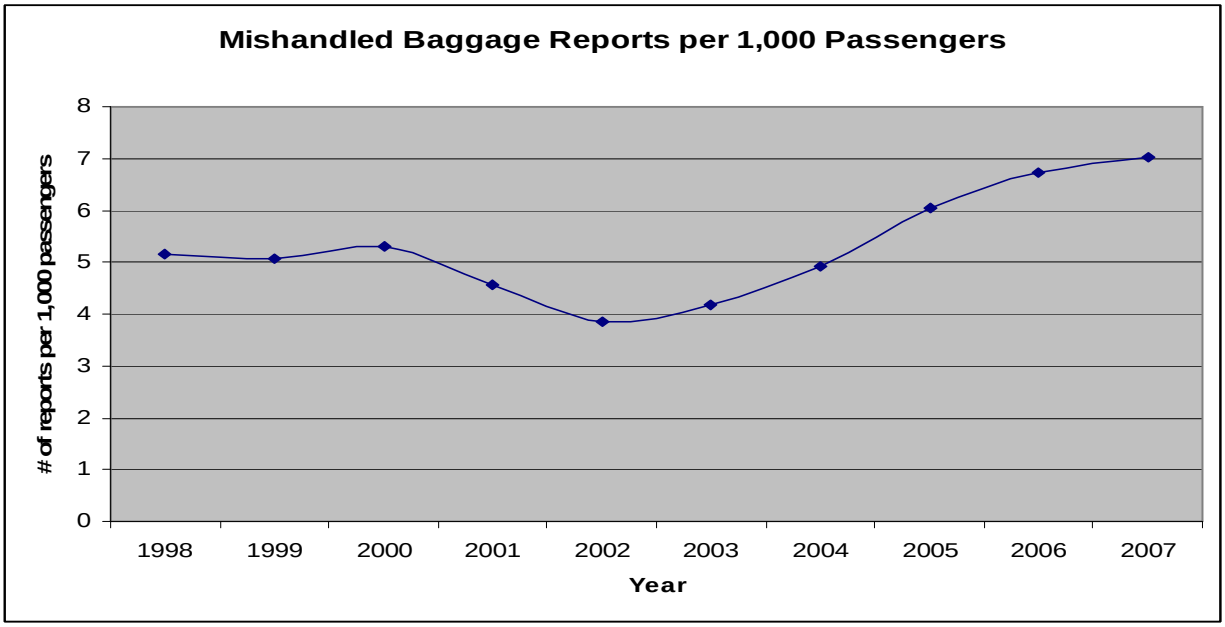


Table 9 and Figure 8 show the number of consumer complaints for the period 1998 – 2007. Notice that this category was at its peak in 2000; however, the number of complaints is on the rise since 2003. This is another indicator that airline LOS seems to be under-performing in recent years.

Table 9: Consumer complaints

Year	Complaints
1998	5,808
1999	13,709
2000	17,072
2001	11,415
2002	6,229
2003	4,002
2004	4,608
2005	5,730
2006	5,746
2007	9,444

Figure 8: Consumer complaints

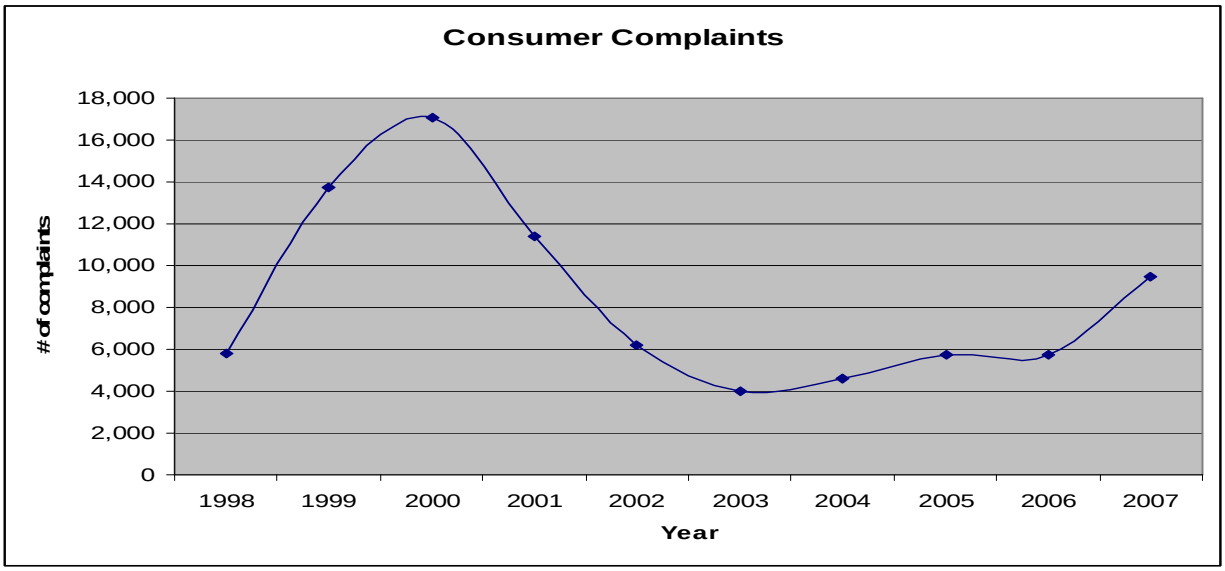
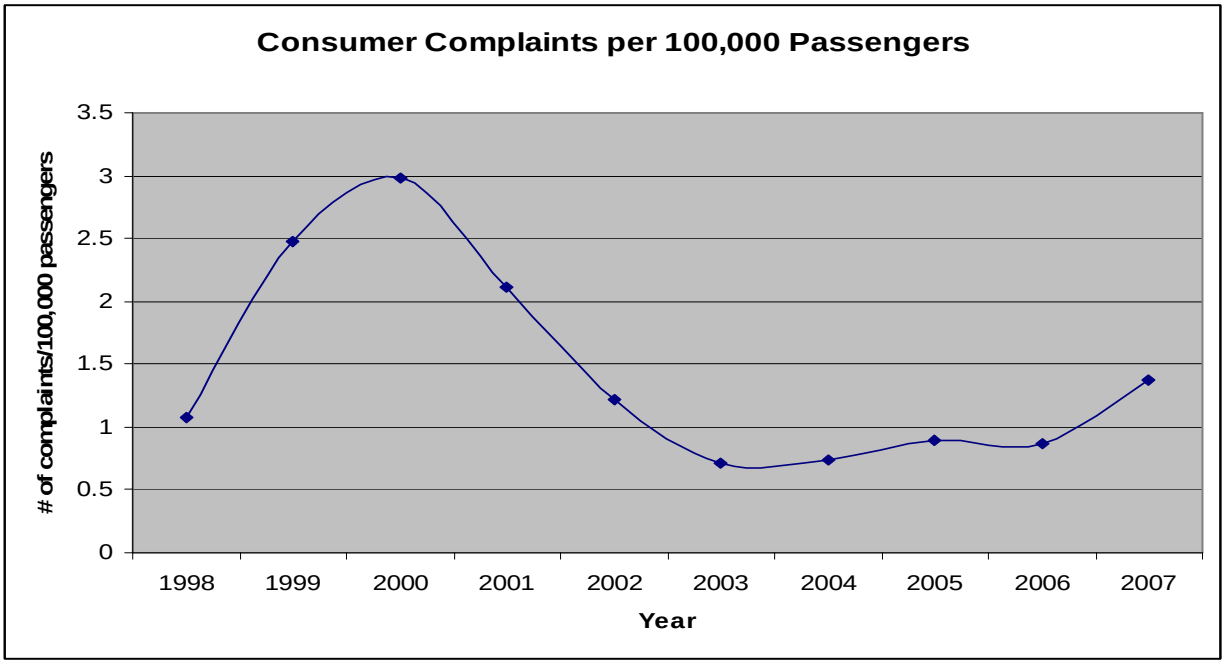


Table 10 and Figure 9 display the number of consumer complaints per 100,000 passengers. This trend line mirrors the one in Table 9 and Figure 8, and shows the upward swing in this category since its lowest level in 2003 – indicating poor trend in LOS by the airlines in recent years.

Table 10: Consumer complaints per 100,000 passengers

Year	Complaints per 100,000 Passengers
1998	1.08
1999	2.48
2000	2.98
2001	2.11
2002	1.22
2003	0.71
2004	0.74
2005	0.89
2006	0.87
2007	1.37

Figure 9: Consumer complaints per 100,000 passengers



6.2 LOS Provided by Regional Airports

According to recently published BTS figures (2008), of this project's list of five domestic airports, only Chicago O'Hare International Airport (ORD) ranked among the top ten for domestic enplanements (see Table 11); however, when international passenger enplanements were added, Detroit's Metropolitan Wayne County International Airport (DTW) was ranked at number nine (see Table 12). Of the other airports listed for this study and among the 854 total US airports, CVG, CLE, and TOL were ranked 30, 35, and 188, respectively, in terms of passenger departures. Similarly, CVG's on-time performance rank in 2007 was #5 for departures and #2 for arrivals; neither CLE, nor TOL were given a rank based on on-time performance as the BTS only ranks major US airports.

Table 11: Top 10 U.S. Airports, ranked by January-November 2007 domestic scheduled enplanements

Passenger numbers in millions (000,000)					
Jan-Nov 2007 Rank	**Airport**	**Jan-Nov 2007 Enplaned Passengers**	**Jan-Nov 2006 Rank**	**Jan-Nov 2006 Enplaned Passengers**	**Percent Change 2006-2007**
1	Atlanta	32.399	1	30.969	4.6
2	Chicago O'Hare	26.158	2	26.244	-0.3
3	Dallas-Ft. Worth	21.670	3	21.750	-0.4
4	Denver	19.499	4	18.580	4.9
5	Los Angeles	18.242	5	17.810	2.4
6	Las Vegas	17.776	6	17.349	2.5
7	Phoenix	16.764	7	16.490	1.7
8	Houston Bush	14.163	8	14.059	0.7
9	Orlando	13.813	10	13.222	4.5
10	Minneapolis-St. Paul	13.149	9	13.315	-1.2
Source: Bureau of Transportation Statistics, T-100 Domestic Market					

Table 12: Top 10 U.S. Airports, ranked by January-November 2007 System* Scheduled Enplanements

Passenger numbers in millions (000,000)					
Jan-Nov 2007 Rank	**Airport**	**Jan-Nov 2007 Enplaned Passengers**	**Jan-Nov 2006 Rank**	**Jan-Nov 2006 Enplaned Passengers**	**Percent Change 2006-2007**
1	Atlanta	39.091	1	37.305	4.8
2	Chicago O'Hare	31.573	2	31.783	-0.7
3	Dallas-Ft. Worth	25.732	3	25.842	-0.4
4	Denver	21.859	5	20.825	5.0
5	Los Angeles	21.840	4	21.145	3.3
6	Las Vegas	19.539	6	19.199	1.8
7	Phoenix	18.915	7	18.694	1.2
8	Houston Bush	18.271	8	18.152	0.7
9	Detroit Metro	15.860	9	15.793	0.4
10	Minneapolis-St. Paul	15.438	10	15.587	-1.0
Source: Bureau of Transportation Statistics, T-100 Market					
* System equals domestic plus international					

Table 13: LOS variables of the Five Regional Airports in this study

5 Study Airports		Gates	Runways	FAA Check Points*	Airline Lounges**	Baggage Carousels	Parking Spaces	**Lounge Operators
ORD	Chicago	178	6	13	23	NA	22,730	United (2), Cont., NW, Delta, AA(2), Aer Lingus, Air France, Alitalia, All Nippon, Australian, BA, JAL, KLM, Korean, Kuwait, Lufthansa, Mexicana, Scandinavian, Turkish, Virgin Atlantic, SwissAir
CVG	Cinci/NKY	136	4	2	3	NA	NA	Delta (3)
DTW	Detroit	145	6	7	2	NA	20,000	Northwest (2) – now merged with Delta
CLE	Cleveland, OH	92	4	3	2	11	7,000	Continental, United
TOL	Toledo, OH	7	2	1	-	2	1,200	

* The number of FAA Check points varies by day and time of day. For this metric column, Monday from 6 AM to 7 AM was chosen.

** The number of airline lounges is listed in this column while lounge operators are shown in the last column on the right.

Table 13 displays the most recent available datum for the LOS variables of the five airports included in this project. The ORD, being one of the largest and busiest facilities in the world, is equipped with the largest number of gates; however, it is followed closely by the next two largest airports in the region - Detroit (DTW) and Cincinnati (CVG), respectively. Detroit's terminal recently received a much needed facelift and is now better able to handle large volumes of passengers and flights. It also increased its number of runways to six which is equal to the number at ORD, a facility that handled almost double the volume of enplaned passengers from January to November of 2007 (see Table 13). This capacity limitation has caused countless delays at ORD in recent years. CVG and CLE both have four runways and TOL is limited to just two. The number of FAA Security Check Points listed is for Monday from 6 to 7 AM only, and seems to be commensurate with the level of passengers at each airport at that particular time.

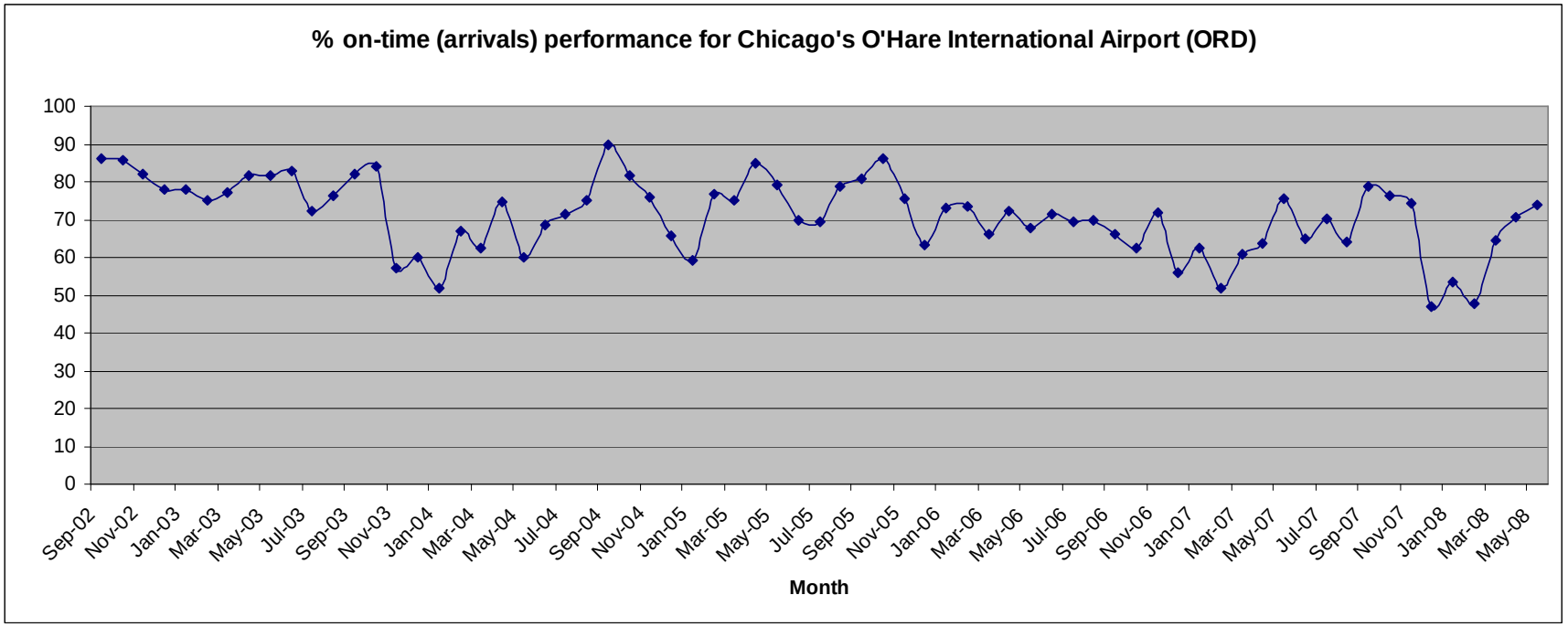
A major international destination, ORD operates 23 airline lounges. An important operations hub for American and United Airlines, they both maintain two separate lounges for their customers, while several international airlines operate lounges there. Surprisingly, DTW is not as heavily filled with airline lounges even though it is an important international departure/destination. It does, however, serve as one of Northwest Airline's (now merged with Delta) major hubs and they maintain two lounges there. Until recently, CVG was a Delta hub and hosted three of their lounges, while CLE is a hub for Continental Airlines. CLE has one Continental lounge and one United Airlines lounge. TOL has no airline lounges.

At the time of this research, information regarding the number of operational baggage handling carousels was unavailable for the three largest airports involved in this region. CLE and TOL listed eleven and two carousels, respectively.

Four of the five regional airports provided information regarding the number of available public parking spaces at their facilities, while CVG did not supply any information. Curiously, ORD only lists 22,730 spaces while DTW boasts 20,000. An important caveat, ORD does offer service to/from downtown and stops along the way via its world-famous “L” train. CLE and TOL offer 7,000 and 1,200 spaces, respectively.

Several tables are presented below and demonstrate the increased demand for domestic air travel and the poor LOS from airlines in recent years.

Figure 10: Percent on-time arrivals performance for ORD



One of the nation's consistently poorest performers according to percentage of on-time arrivals, ORD regularly ranks toward the bottom of this FAA category. The Federal Aviation Administration keeps tabs on arrival and departure performance for the country's top 32 airports. As one of the busiest facilities not only in the US but also the world, ORD suffers from some of the nation's worst monthly arrival performances. Notice that ORD recorded its lowest ratings over the winter months of 2007 – 2008. During this study period, ORD averaged 71.04% on-time arrival performance.

Map 2: Geographic Locations of Top 32 Airports of the Country

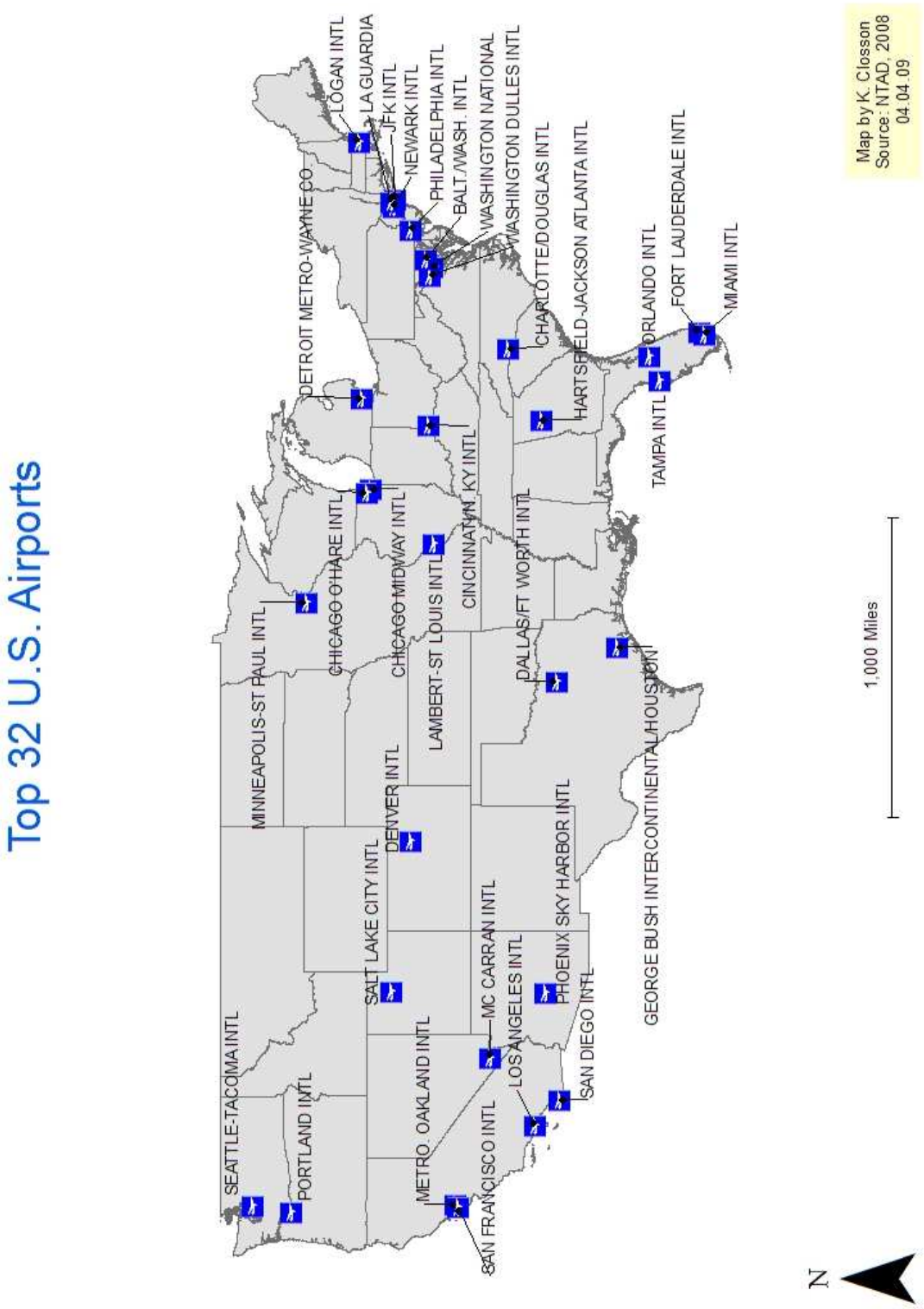
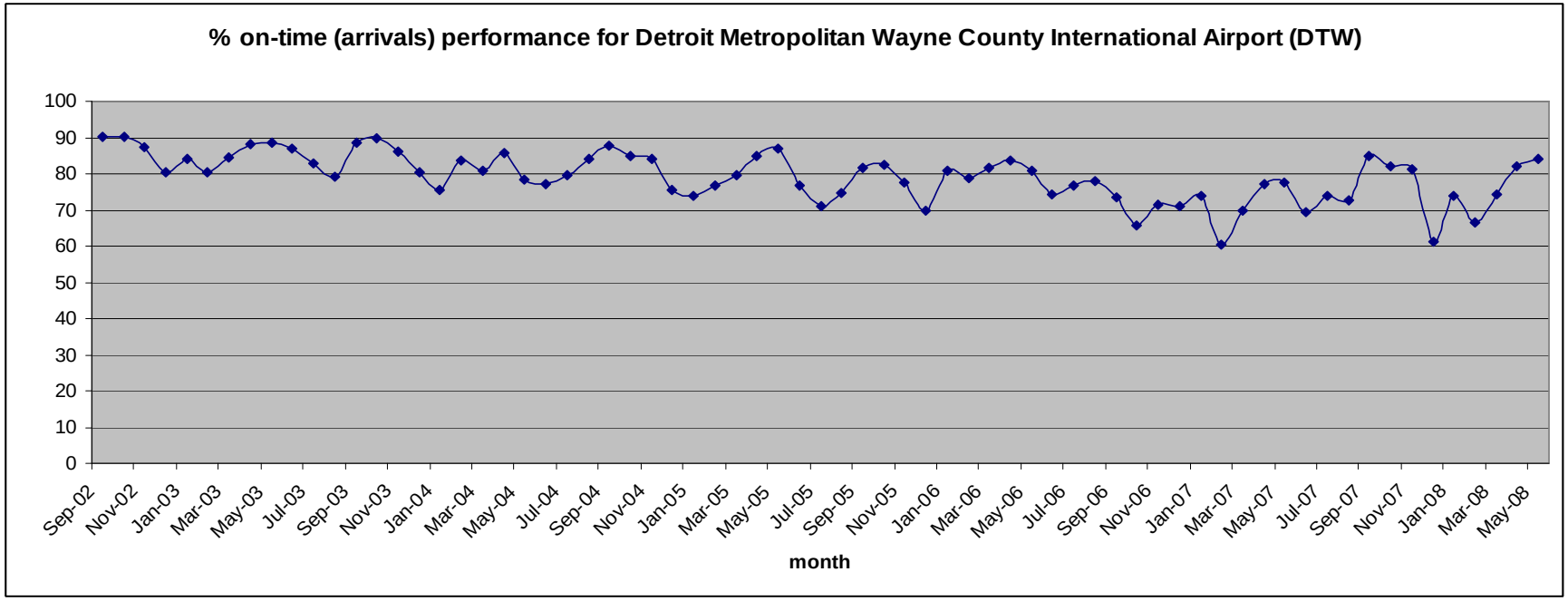
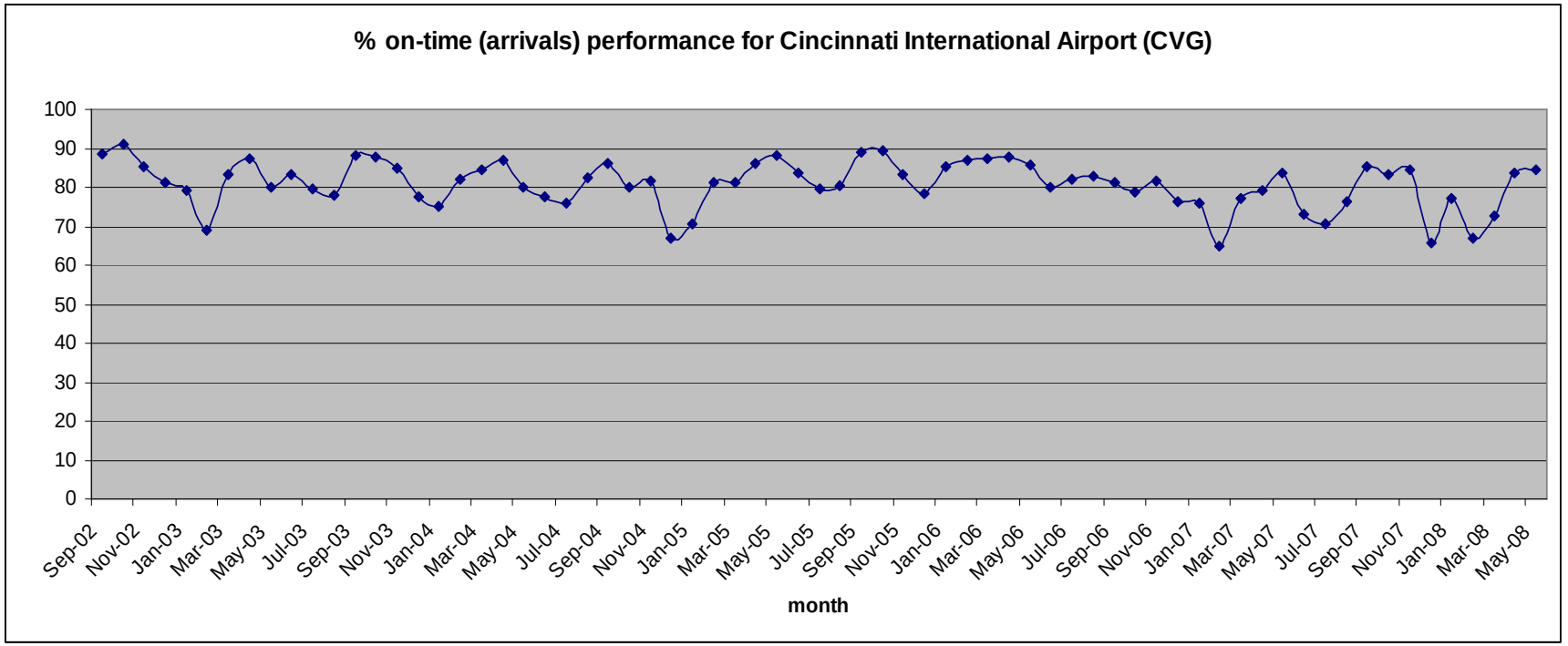


Figure 11: Percent on-time arrivals performance for DTW



Also a busy facility, DTW typically performs slightly better than ORD on a regular monthly basis; however, it is still not uncommon for this airport to see its percentages in the 60 – 70% range. Although DTW does not handle the volume of traffic that ORD does, it still manages to perform better in this category. The mean percent on-time (arrivals) performance of DTW over this time period is 79.17%.

Figure 12: Percent on-time arrivals performance for CVG



Cincinnati International Airport (CVG) regularly scores better than both DTW and ORD in percent on-time arrival performance. It is not unusual for CVG to be ranked among the top five airports for this performance metric. CVG's average percent on-time arrival performance from September 2002 to May 2008 was 80.8%.

Figure 13: Composite of percent on-time arrivals performance for CVG, DTW, and ORD

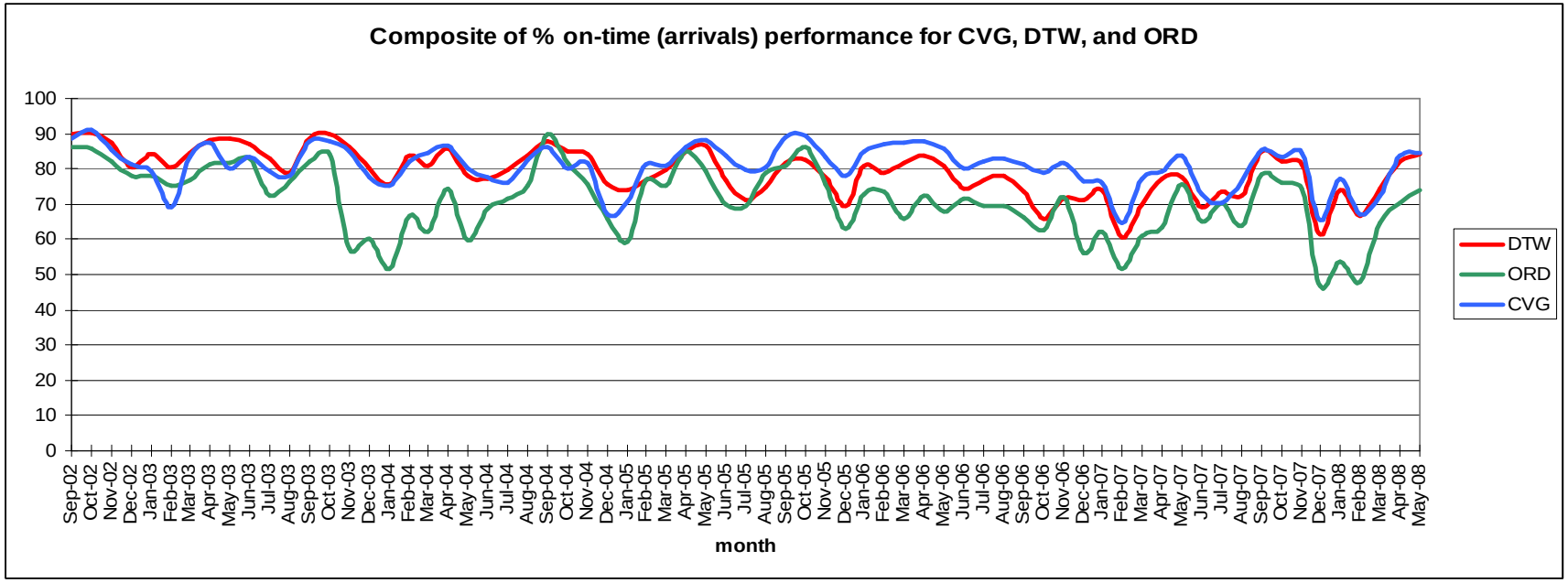
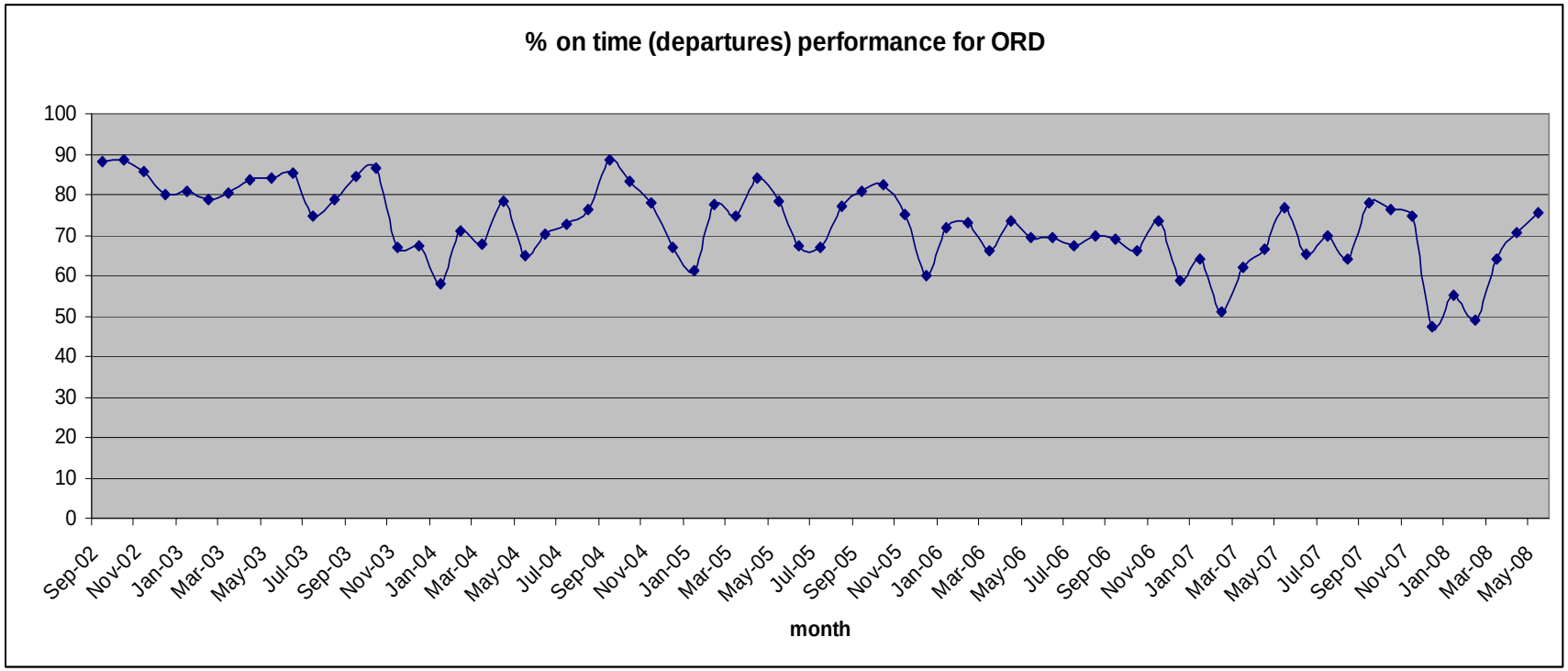


Figure 13 combines the single trend lines of the previous three figures. It reinforces the aforementioned fact that ORD typically performs worst among these three facilities, while CVG is most often the best of these regional airports. As mentioned above, the average percent on-time (arrival) performance for ORD, DTW, and CVG during this period was 71.04%, 79.17%, and 80.8%, respectively. ORD's performance were worst in the winter of 2003-2004 and again in the winter of 2007-2008 indicating that the airport facilities cannot provide good service to the passengers in inclement weather that may lead to closure of a runway or any other facilities.

Figure 14: Percent on-time departures performance for ORD



Not unlike its performance rating for arrivals, ORD's percent on-time departures performances are among the nation's lowest. ORD's mean percent rating for this metric over this study period was 72.37%. It reached its lowest rate between January and March 2008 with less than 50% flight departure. This indicates that during this 3-month period of 2008, less than half of scheduled flights left ORD for their destination – an example of extremely poor LOS provided by the airport.

Figure 15: Percent on-time departures performance for DTW

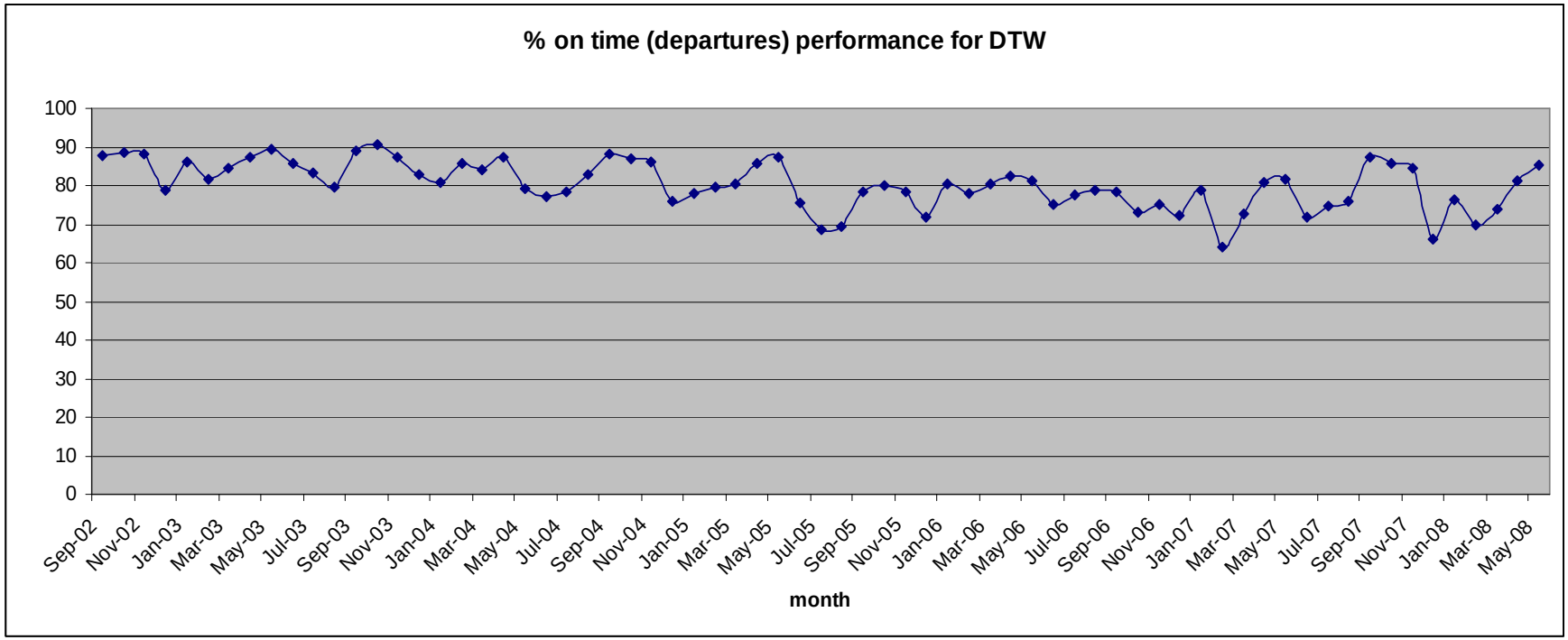
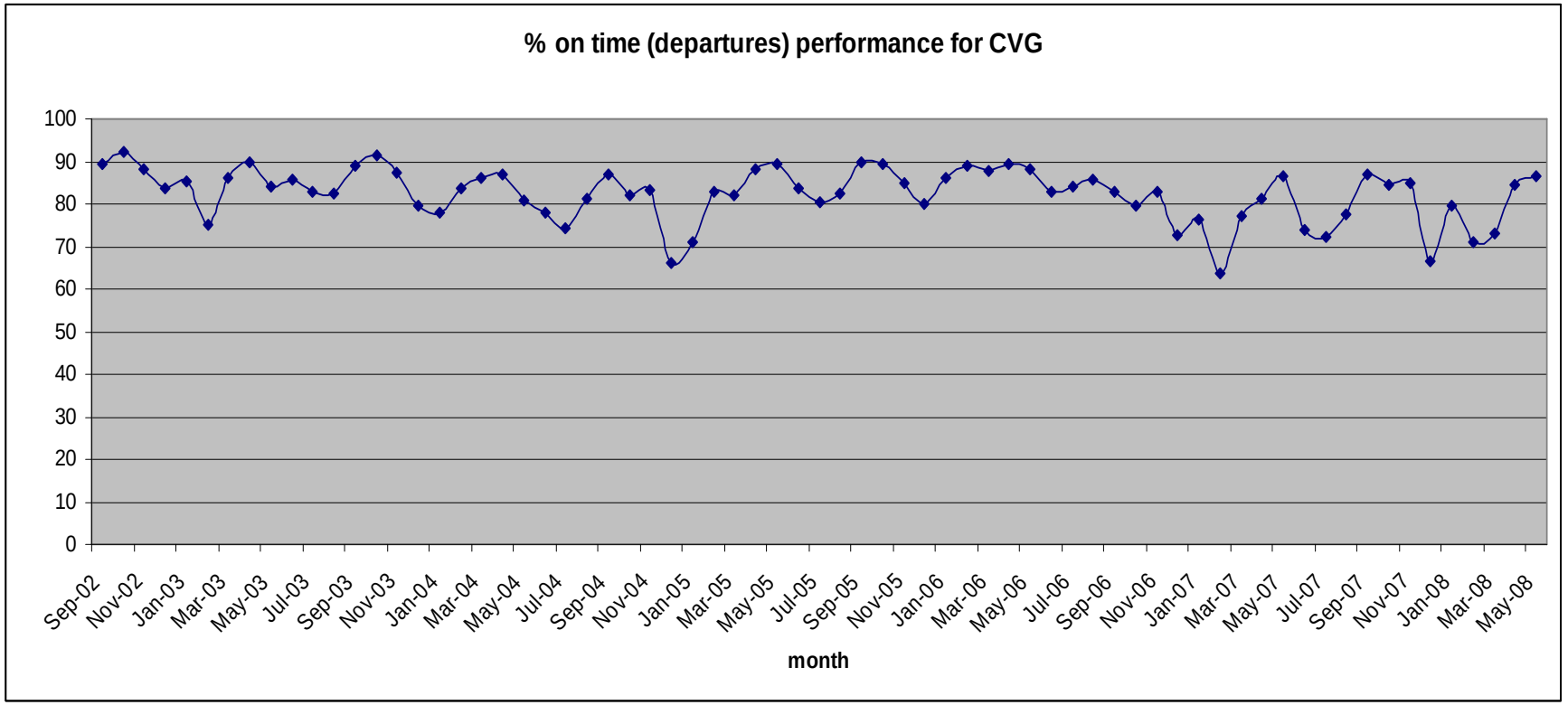


Figure 15 shows DTW's on-time departures performances based on percentage. It closely mirrors its arrivals performance rating. DTW typically holds a monthly ranking somewhere near the middle of the top 32 airports, according to the FAA. The mean percent on-time departures performance for DTW from September 2002 to May 2008 was 80.27%. The lowest rate of departure was between 60% and 70% in January 2008.

Figure 16: Percent on-time departures performance for CVG



Like its arrivals performance, CVG's departures performances are among the highest of the nation's top 32 airports with a mean of 82.34% on-time departures. CVD reached it lowest rate of departure with a value of over 60% in May 2007. Otherwise, CVG's performance is much better than ORD and DTW.

Figure 17: Composite of percent on-time departures performance for CVG, DTW, and ORD

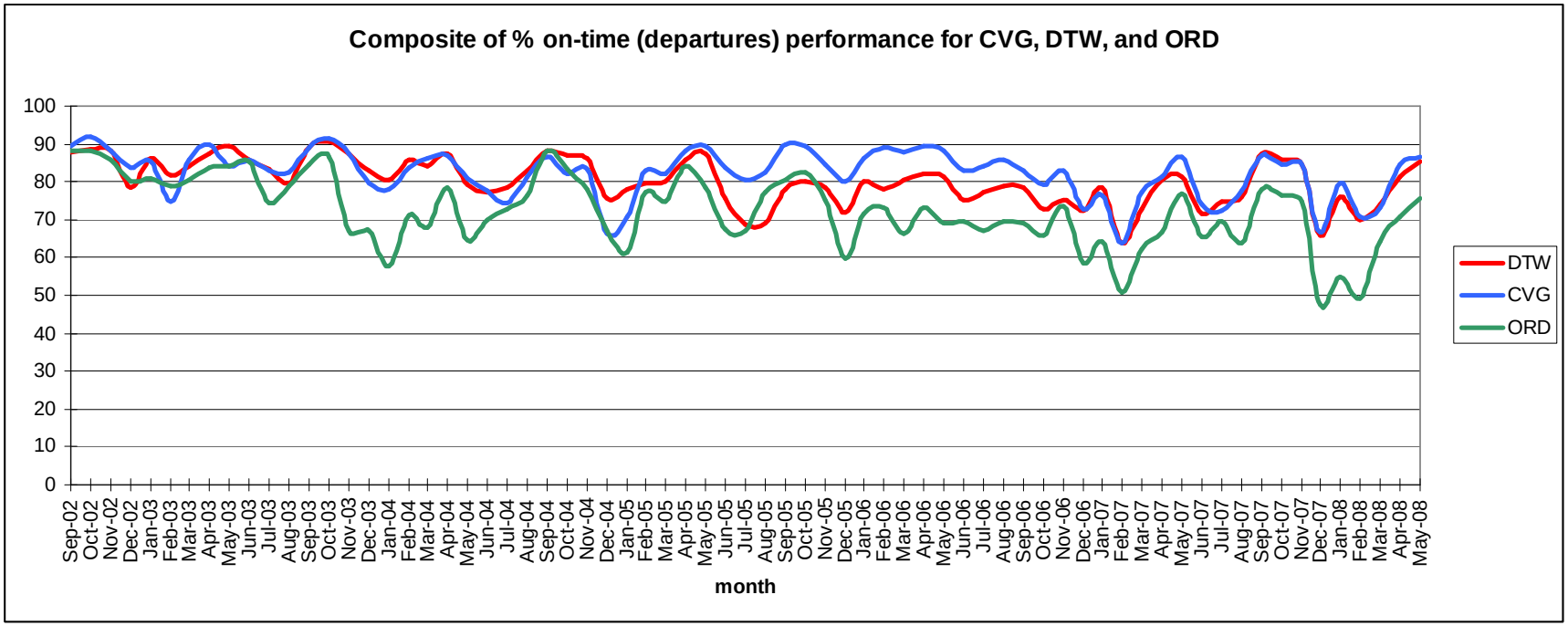
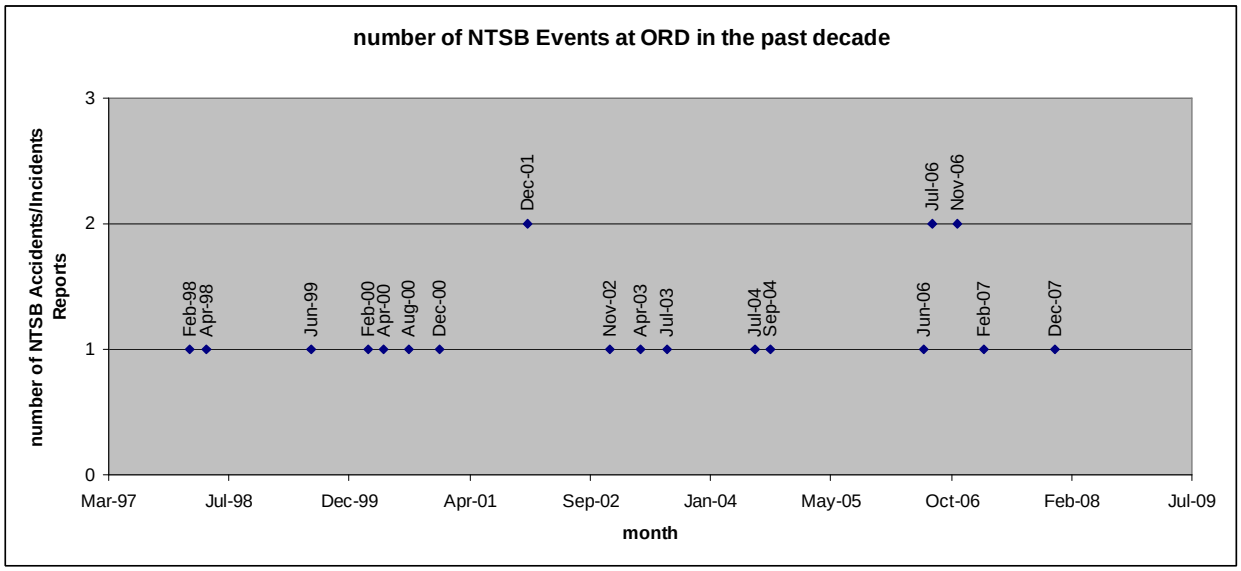


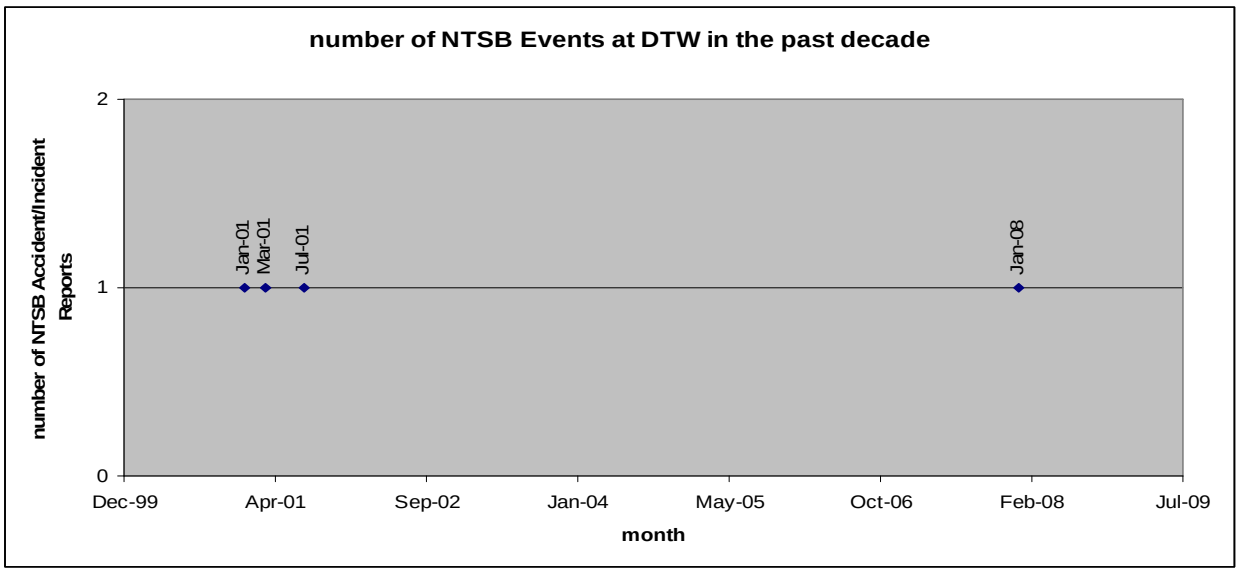
Figure 17 displays all three facilities' percent on-time departure performance rating from September 2002 to May 2008. The trend lines closely mimic the arrival performance percentages. The performances of CVG, DTW and ORD in terms of on-time departures performance were 82.34%, 80.27%, and 72.37%, respectively during the same period. The researcher could not obtain the same data for CLE and TOL. However, the study assumes that the departure rates of these two airports would be better than CVG, DTW and ORD since there is considerably less air traffic in these two small airports than CVG, DTW and ORD.

Figure 18: Number of NTSB 'Events' at ORD in the past 10 years



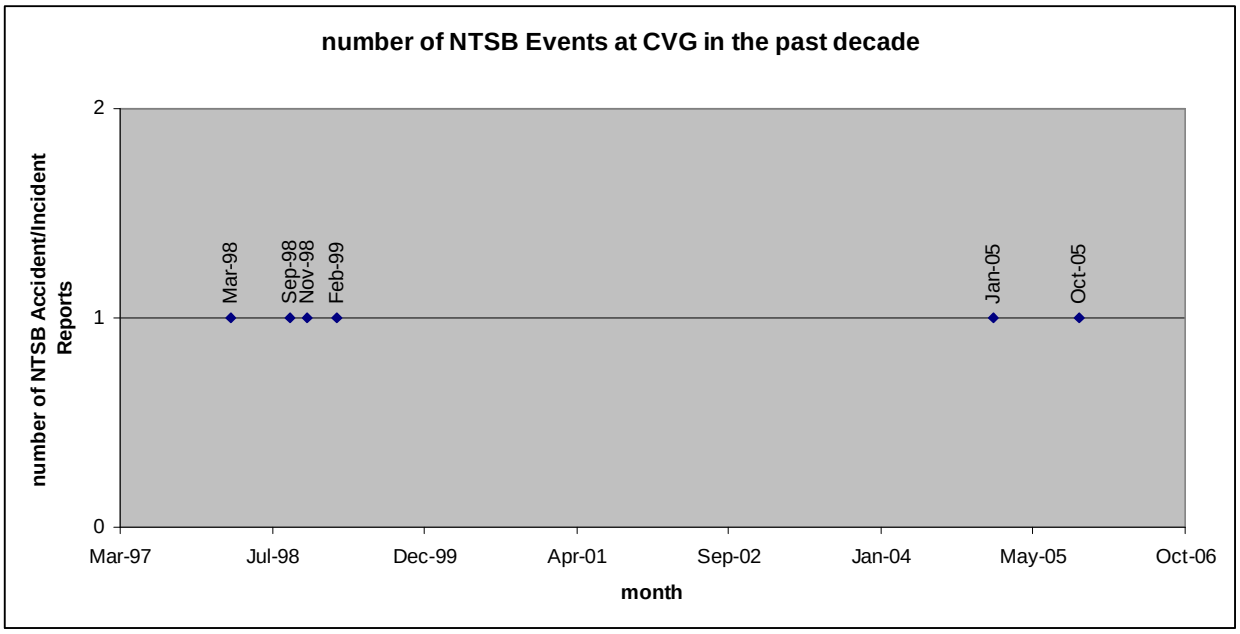
As one of the nation's busiest facilities, it is not surprising that there have been 21 NTSB Accident/Incident 'Events' at ORD in the past decade. It is also not surprising that American Airlines and United Airlines have recorded more 'Event' reports at ORD than other major airlines, as these two carriers account for a large percentage of ORD's flight traffic.

Figure 19: Number of NTSB 'Events' at DTW in the past 10 years



Only four Accident/Incident 'Event' reports have been filed by the NTSB at DTW in the past ten years, with three of those occurring in 2001. Its most recent safety blemish happened in January, 2008. As a hub for Northwest Airlines (now merged with Delta), it is not surprising that this carrier has recorded the largest number of 'Event' reports at DTW.

Figure 20: Number of NTSB 'Events' at CVG in the past 10 years



Six NTSB Accident/Incident 'Event' reports have been recorded at CVG over the past decade. The dominant airlines at CVG, Delta and its partner, Comair, have recorded the most 'Event' reports of any airline at that facility by far.

Figure 21: Number of NTSB 'Events' at CLE in the past 10 years

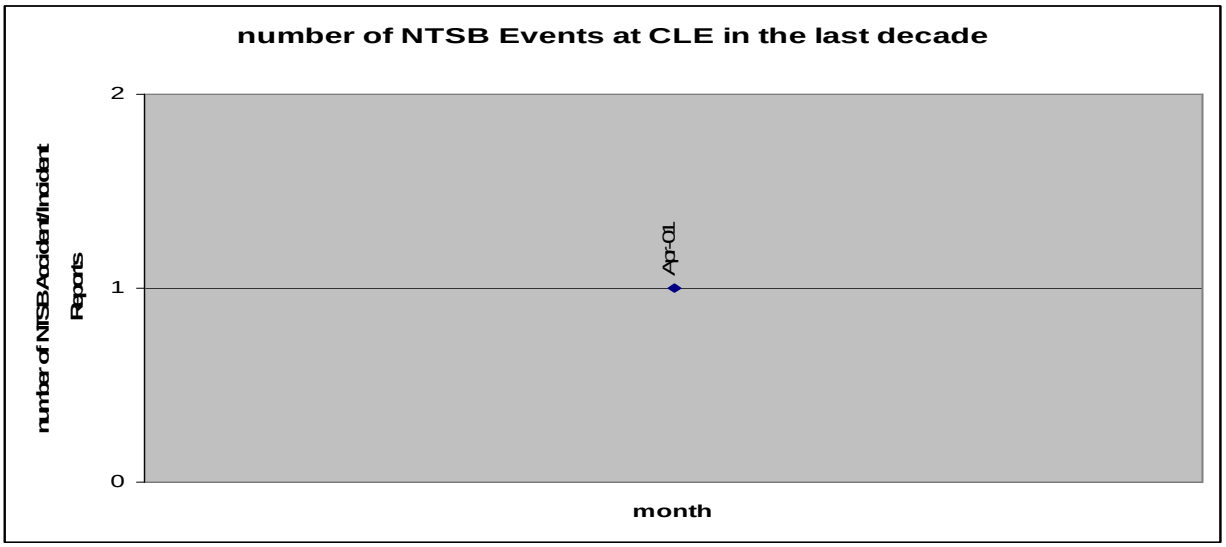


Figure 21 shows the one NTSB Accident/Incident 'Event' report that was reported at CLE in April, 2001. An American Eagle Airlines flight was responsible for this 'Event'.

7 Conclusions

The study reveals that despite the devastating act of 11 September 2001 the domestic air travel demand has gone up while the LOS measures for most of the indicators have fallen during the last decade. The specific causes for such increase in air travel demand could not be determined from the BTS and DOT datasets. Another study is needed to find out such causes, which will be based on surveys of departing and arriving passengers at the airport gates, and surveys of airport and airlines administrators. Conducting such surveys was beyond the scope of this study. Therefore, this study could not determine the causes of air travel demand based on fact; however, the lower air fare due to more competition among many airlines could be attributed to such demand increase.

It is apparent from the study that air travel demand at ORD has crossed the threshold air infrastructure utilization level while the situation is still under control in four other regional airports that were considered for this study. Given its huge volume of air traffic, it is not surprising to see ORD's performance records among the lowest of the nation's top 32 airport facilities and five regional airports of this study. The FAA (2007) has rightly recognized ORD's need for upgrades and infrastructure improvements. This study supports the idea that ORD will need better facilities in the near future. Interestingly, Chicago's bid to host the 2016 Summer Olympics may bolster ORD's upgrade forecast. Of the facilities examined in this report, it appears that DTW, CVG, and to a lesser extent CLE and TOL are performing well with the infrastructure already in place. Therefore, this report does not suggest DTW, CVG, CLE, or TOL as needing immediate expansions or improvements of their infrastructure facilities. The datum, however, points to the growing concern for ORD and its low LOS.

8 Recommendations

The study finds that ORD is failing to provide satisfactory LOS to its passengers while other regional airports – DTW, CVG, CLE, and TOL are doing better. The study also finds that DTW and ORD have same number of runways while ORD is the busiest airport in the nation and one of the busiest in the world. It appears that ORD is not capable of serving all flights and passengers with current number of runways and other infrastructure like number of seat space per passenger and number of gates. It has been consistently providing unsatisfactory LOS in other aspects like luggage handling, involuntary denial of boarding, passenger complaints, etc. Therefore, the study recommends that ORD expand its runways by adding few more. It also recommends that ORD expand its other infrastructure like number of gates and number of seats

for passengers. Alternatively, ORD could think of reducing its daily toll of arrival and departure flights by diverting some to other airports like DTW and Chicago Midway Airport (MDW). The study does not recommend any further expansion of infrastructure in DTW, CVG, CLE, and TOL as it stands now. However, these airports may need to add additional infrastructure facilities in future if the air travel demand further increases in the region.

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