Portland International Airport

Recommendation Assessment Study

JULY 1999

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PORTLAND INTERNATIONAL AIRPORT

(PDX)

RECOMMENDATION ASSESSMENT STUDY

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Introduction

Recognizing the problems posed by congestion and delay within the National Airspace System, the Federal Aviation Administration (FAA), airport operators, and aviation industry groups initiated joint airport Capacity Design Teams at various major air carrier airports throughout the U.S. Each Capacity Design Team identified, evaluated, and developed alternative means to enhance existing airport and airspace capacity to handle future demand, decrease delays, and improve airport efficiency. Under the sponsorship of the Office of System Capacity (ASC), with technical analysis provided by the William J. Hughes Technical Center, more than 40 airport design team studies have been completed.

With this number of design team studies completed, many recommendations have been carried out at these airports. Because of this, ASC initiated the requirement to perform Recommendation Assessment Studies to determine how the actual benefits of improvements compare to the benefits predicted in the Design Team Studies. Portland International Airport is one of two airports identified to have a Recommendation Assessment Study performed in fiscal year 1999.

The Portland International Airport Capacity Design Team Study was initiated in 1994 and a formal report of the results of the study was published in October 1996. The major recommendation of the study was the installation of a CAT I ILS on Runway 10L which would allow 1.5 nautical mile staggered dependent CAT I approaches in IFR- 1 and independent straight-in approaches in VFR-2. The ILS was installed and commissioned on June 20, 1996. This improvement has been in use for over two years, thus making Portland International Airport (PDX) a likely candidate for a Recommendation Assessment analysis.

Unfortunately, airport construction has been ongoing since the installation of the ILS and prevented the improvement from being fully utilized. In addition, the construction adversely affected operations in all weather conditions, including VFR-1, a condition in which the ILS would not be utilized. Thus, the construction made it more difficult to make a complete assessment of the improvement.

Assessment Methodology

The basic methodology employed in the recommendation assessment is to compare annual delay values appearing in the 1996 Portland International Airport Capacity Enhancement Plan to the Consolidated Operations and Delay Analysis System (CODAS) data. The predicted delay values for the years 1997 and 1998 are determined by interpolating the annual delay values reported in the Portland International Airport Capacity Enhancement Plan and comparing them to the delays obtained from the CODAS data for the same years.

Recommendation Assessment Analysis

PDX had 329,745 operations in 1997 and 326,259 operations in 1998. Predicted delay values for these demands were obtained and compared to CODAS data for 1997 and 1998, which are shown in Tables 1 and 2, respectively. The numbers in the column titled "Total per Operation" indicate the average delay per operation by month and for the year. The CODAS data shows that the average delay per operation for 1997 was 2.64 minutes and the average delay per operation for 1998 was 2.83 minutes.

The Portland International Airport Design Team Study, initiated in 1994, used a Baseline demand schedule and profile based on an average-day peak-month in 1994. The 1993 annual demand of 281,000 operations was used as the Baseline demand. Two additional demand levels of 386,000 and 491,000 operations were used for Future 1 and Future 2, respectively. Simulations for each configuration and improvement were performed at each demand level to develop the annual delays shown in Figure 2 of the Portland Airport Capacity Enhancement Plan and Figure 1 of this report.

Figure 2 on page 7 of the Plan shows that for the Basecase the total annual delay was 5,670 hours at Baseline demand, 40,938 hours at Future 1, and 201,837 hours at Future 2. The figure also indicates the annual saving predicted for Improvement 7A, 1.5nm staggered approach to ILS Runway 10L, would be 1,111 hours at Baseline demand, 16,952 hours at Future 1, and 65,457 hours at Future 2. Subtracting the savings from the Basecase "do nothing" delays yields annual delays with the ILS improvement of 4,559 hours at Baseline demand, 23,986 hours at Future 1, and 136,380 hours at Future 2.

The approach in determining the annual delay for 329,745 operations in 1997 was to perform a straight-line interpolation between the delays for Baseline and Future 1. The determination of annual delay for 326,259 operations in 1998 was performed in a similar way.

The predicted annual delays obtained from straight-line interpolation, converted to minutes of delay per operation for the 1997 and 1998 demand levels, were 2.25 minutes and 2.16 minutes, respectively. Comparing the predicted value of 2.25 minutes per operation to the CODAS value of 2.64 minutes per operation for 1997 shows the predicted value was 14.77% less than reported by CODAS. For 1998, the predicted value of 2.16 minutes per operation was 23.67% less than the CODAS value of 2.83 minutes per operation.

However, PDX reported that Runway 10R/28L, the 11,000 ft. CAT III runway, was repaved over a four year period starting in the summer of 1995 through 1998. Construction ran from June to November (with some variation for weather). The runway was closed six days a week from 3pm to 5am. During the closure, the north runway 10L/28R and the crosswind runway were used. The closure affected arrivals and departures in all weather conditions, including those which did not require the additional ILS. The closure prevented Improvement 7A from being used when necessary during this

time period and resulted in a less efficient operation, not only in VFR-2 and IFR-1, but in all weather conditions. Consequently, the closure resulted in reduced savings for the improvement and higher annual delays.

If the assumption is made that the likelihood of IMC weather is equal throughout the day and throughout the year, then the time available for the use of this improvement would be reduced 25%. This value was obtained by multiplying the percentage of months of construction in a year, by the percentage of days in the period, and by the percentage of hours of closure during the day.

Since the improvement would be beneficial only during the busy portion of the day, then 18.75% would be a better estimate of the unavailability of the improvement. This percentage was obtained by examining the hourly demand profile in Figure 9 on page 25 of the Capacity Enhancement Plan (Figure 2 of this report). The runway would be unavailable from 3pm to 10pm, which is 7/16 of the busy portion of the day (6am to 10pm) and represents the percentage of hours of closure during the day in the calculation.

The ILS improvement benefits were reduced by 18.75% and the recalculation resulted in revised predicted delays of 2.51 minutes per operation for 1997 and 2.40 minutes per operation in 1998. For 1997, the predicted delay value of 2.51 minutes per operation is 4.9% lower than the 2.64 minutes per operation reported by the CODAS. For 1998, the predicted value of 2.40 minutes per operation is 15.2% lower than the 2.83 minutes per operation reported in the CODAS data.

Runway construction and revised operating procedures caused by the runway closure affected operational efficiency in all weather conditions. This created many uncertainties in the analysis. Therefore, the assessment of the improvement is as precise as possible without undergoing a very time consuming and costly analysis to scrutinize daily weather, operational procedures, and delay information during the construction period.

TABLE 1

Portland International Airport
CODAS: Detail Report
1997

Date	Airport	Departures	Arrivals	EDCT Where Taken	EDCT Where Caused	Total Gate Delay	Adjusted Gate Delay	Taxi Out	Airborne	Taxi In	Total Outbound	Total Inbound	Total per operation	Arrival Delay
Jan-97	PDX	9120	9110	0.73	0.00	10.63	1.63	1.33	2.20	0.46	2.96	2.66	2.81	13.06
Feb-97	PDX	7678	7684	0.38	0.00	7.76	0.71	1.44	2.10	0.45	2.15	2.54	2.35	9.18
Mar-97	PDX	9338	9246	0.14	0.00	6.89	0.56	1.44	1.87	0.53	2.00	2.41	2.20	8.46
Apr-97	PDX	9334	9312	0.26	0.00	6.48	0.48	1.55	2.08	0.47	2.03	2.55	2.29	8.49
May-97	PDX	9791	9616	0.04	0.00	5.25	0.31	1.58	1.67	0.55	1.89	2.22	2.05	6.12
Jun-97	PDX	9633	9510	0.09	0.00	6.62	0.60	1.80	1.67	0.55	2.40	2.22	2.31	8.37
Jul-97	PDX	10186	10037	0.12	0.00	6.74	0.37	2.30	1.50	0.58	2.67	2.08	2.38	8.37
Aug-97	PDX	9972	9759	0.29	0.00	8.08	0.47	2.20	1.56	0.61	2.67	2.18	2.43	10.00
Sep-97	PDX	9469	9300	0.10	0.01	6.54	0.35	2.13	2.02	0.66	2.48	2.68	2.58	7.31
Oct-97	PDX	9384	9261	0.27	0.00	8.45	0.55	2.52	3.01	0.86	3.07	3.87	3.47	10.64
Nov-97	PDX	8889	8780	0.38	0.00	7.84	0.94	1.70	2.92	0.84	2.64	3.76	3.20	9.73
Dec-97	PDX	9719	9616	0.33	0.00	10.67	0.95	2.09	3.36	0.78	3.04	4.13	3.58	13.32
Totals	PDX	112513	111231	0.26	0.00	7.65	0.65	1.85	2.15	0.61	2.50	2.77	2.64	9.41

TABLE 2

Portland International Airport
CODAS: Detail Report
1998

Date	Airport	Departures	Arrivals	EDCT Where Taken	EDCT Where Caused	Total Gate Delay	Adjusted Gate Delay	Taxi Out	Airborne	Taxi In	Total Outbound	Total Inbound	Total per operation	Arrival Delay
Jan-98	PDX	8771	8689	0.92	0.00	9.71	1.71	2.26	2.99	0.79	3.95	3.78	3.87	11.82
Feb-98	PDX	8040	7910	1.15	0.00	8.32	1.46	1.46	2.60	0.60	2.92	3.21	3.06	10.72
Mar-98	PDX	8612	8463	0.71	0.00	7.20	1.08	1.48	2.16	0.59	2.56	2.75	2.66	8.68
Apr-98	PDX	8868	8660	0.30	0.00	5.70	0.49	1.46	1.78	0.51	1.94	2.29	2.11	7.74
May-98	PDX	9021	8872	0.76	0.00	6.73	1.03	1.72	2.15	0.52	2.76	2.67	2.72	8.49
Jun-98	PDX	9048	8838	0.61	0.00	7.68	1.16	2.01	1.73	0.44	3.17	2.17	2.67	11.14
Jul-98	PDX	9887	9627	0.59	0.00	7.83	0.87	2.19	1.46	0.54	3.06	1.99	2.53	9.61
Aug-98	PDX	9693	9467	0.52	0.00	6.60	0.70	2.37	1.30	0.56	3.07	1.86	2.47	7.94
Sep-98	PDX	9354	9098	0.46	0.00	6.27	0.71	2.07	1.76	0.37	2.78	2.14	2.46	6.45
Oct-98	PDX	9800	9551	0.43	0.00	6.60	0.67	1.69	2.13	0.42	2.37	2.55	2.46	9.11
Nov-98	PDX	9278	9192	0.73	0.00	7.93	1.31	1.47	3.03	0.55	2.78	3.58	3.18	9.76
Dec-98	PDX	10178	9998	0.50	0.00	12.17	1.14	2.55	3.14	0.70	3.69	3.84	3.76	16.00
Totals	PDX	110550	108365	0.63	0.00	7.74	1.02	1.91	2.18	0.55	2.93	2.73	2.83	9.82

FIGURE 1

Capacity Enhancement Alternatives and Annual Delay Savings

Basecase	Estimated Annual Delay Costs (in hours and millions of 1994 dollars) Baseline (281,000)	Future 1 (386,000)	Future 2 (491,000)
2.5 nm In-trail ifr Spacing Between Like Class Aircraft on Final Approach	5,670/$6.8	40,938/$49.1	201,837/$242.2

Airfield Improvements	Estimated Annual Delay Savings (in hours and millions of 1994 dollars) Baseline (281,000)	Future 1 (386,000)	Future 2 (491,000)
1. Improve Exit Taxiways on Runway 10l/28r		Narrative	
2. Build New Exit Taxiways for Runway 10r/28l		Narrative	
3. Build Taxiway Exits B-3 & B-4 (with enlarged fillets) North of Runways 10r/28l		Narrative	
4. Build a N/S Taxiway Connecting East Ends of Parallel Runway			
Combined Savings of 4 and 10			
Without 7A and Without 7C	684/$0.8	4,977/$6.0	45,200/$54.2
With 7A and 7C	2,515/$3.0	30,801/$36.1	149,015/$178.8
5. Build Penalty Boxes		Narrative	
6. Build Departure Pads on the Ends of Runways 10r/28l, 28r		Narrative	
Operational Improvements			
7. Staggered cat i Instrument Approaches			
A. 1.5 nm Stagger, ils Runway 10l (East Flow)	1,111/$1.3	16,952/$20.3	65,457/$78.5
B. 1.5 nm Stagger, mls Runway 28l (West Flow)	269/$0.3	4,706/$5.6	9,775/$11.7
Combined Savings of 7a and 7b above	1,380/$1.6	21,658/$25.9	75,232/$90.2
C. 1.5 nm Stagger ils Capability Runway 28l (West Flow)	530/$0.6	7,971/$9.6	32,273/$38.7
Savings of 7c over 7b above	261/$0.3	3,265/$4.0	22,498/$27.0
Combined Savings of 7a and 7c above	1,641/$1.9	24,923/$29.9	97,730/$117.2
8. Simultaneous (Independent) cat i Approaches to All Parallel Runways	1,753/$2.1	25,334/$30.4	98,647/$118.4
9. Immediate North Divergent Turn for Turbo Props in Both Flow Directions	487/$0.6	3,596/$4.3	32,897/$39.5
10. Immediate Divergent Turns for All Aircraft	684/$0.8	4,018/$4.8	35,089/$42.1
11. Peak Period Use of Runway 3 for Arrivals by Small Cargo Aircraft	84/$0.1	679/$0.8	2,342/$2.8

Note: The savings for Improvements 9 or 10 may be added to those of Improvements 1 through 3 and Improvements 5 through 8.

FIGURE 2

Profile of Daily Demand - Hourly Distribution