Impact of Projected Air Travel Demand On Airport Access

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The problem of access to airports has received increased attention in the public media as major airports experience congestion caused by recent rapid increases in air travel demand. This paper examines the projected air travel demands at key airports in the nation, reports the steps being taken to improve airport access, and identifies areas for research to achieve adequate access to airports on a long-range basis.

•STEADY GROWTH in air travel demand is now making it mandatory that city, state, and national transportation officials plan in terms of total transportation systems, including increased emphasis on adequate ground access to airports. Rising population and its concentration in metropolitan areas have been key factors accounting for the steady increases in both passenger and cargo traffic. Significant factors during the 1960's were the introduction of jet service to cities served by trunk airlines and the relative stability of air travel fares while more desirable schedules and improved comfort were being provided.

By 1970, we expect all of the approximately 200 airports that now have trunk air arrier service to have jet service. The regional air carriers that serve approximately 300 intermediate points will have converted to jet equipment by the early 1970's. Figure 1 shows the growth of jet service for U.S. scheduled airlines.

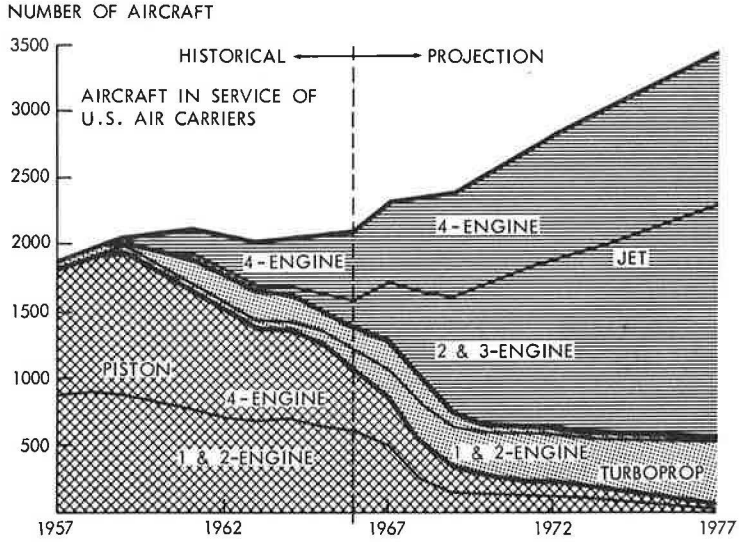

Figure 1. Growth of jet service for U.S. scheduled airlines.

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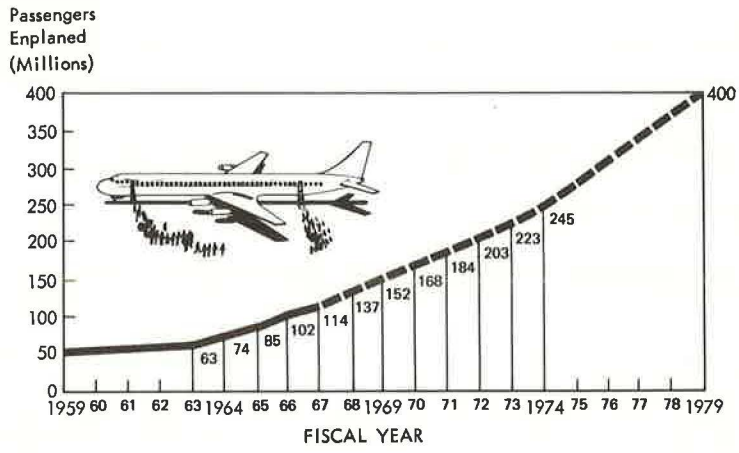

Figure 2. Domestic air carrier revenue passengers and forecast to 1979.

Figure 2 shows the historical trend for scheduled air carrier passenger traffic through fiscal year 1967 and FAA projections for the 1970's. FAA conservatively predicts an increase in revenue passenger enplanements of approximately 11 percent per year. In comparison with other common carriers, air transportation has shown the most rapid growth in intercity passenger travel. Although air transportation penetration of the shorter distance markets (up to 250 miles) has been limited, it is the predominant common carrier for trip distances of 500 miles and over.

The 1970's will see the introduction of new types of aircraft in the air carrier fleet, with passenger-carrying capacities far beyond those in existence today. These aircraft will discharge a much greater number of people into the passenger terminals, and the supersonic aircraft will greatly increase the speed of the air trip as well. Following is a summary of the characteristics of these significant new aircraft.

Aircraft	Description and Capacity
Boeing B-747	4-engine, 600+ mph; 363-447 passenger capacity; long-range
Douglas DC-10	3-engine, 600 mph; 250 passenger capacity; short-, medium-, and long-range
Lockheed L-1011	3-engine, 600 mph; 220-300 passenger capacity; medium- and long-range
Concorde	4-engine, 1,450 mph; 135-145 passenger capacity; long-range
Boeing B-2707	4-engine, 1,800 mph; 300-350 passenger capacity; long-range

To determine the significance of demand forecasts to the development of airport facilities, FAA initiated a nationwide effort to estimate both future aviation demand and facility requirements. The first results were released in 1967 in the FAA publication "Aviation Demand and Airport Facility Requirement Forecasts for Large Air Transportation Hubs Through 1980." Such forecasts were designed for use in advance planning of airport facilities required to meet the air transportation needs of the 1980's.

The scope of this initial effort was limited to 22 metropolitan areas classified as large hubs—communities that generate 1 percent or more of the nation's scheduled air

carrier domestic enplaned passengers. The future needs of the large hubs, classified according to type of civil uses (air carrier and general aviation), were quantified in units or area requirements for facilities such as passenger terminal buildings, cargo buildings, aircraft aprons, and public vehicle parking areas.

Individual airport facility requirements were not included in these forecasts. The actions necessary to obtain maximum use of the forecast data are as follows:

1. Assessment of the currently available airport facilities within each hub;
2. Determination of the additional facilities needed at each location in order to adequately meet the anticipated demand; and
3. Development of a comprehensive, long-range airport system plan for each metropolitan area to ensure the timely construction of the required airport facilities.

The magnitude of airport aviation activity and related facilities needed in the large hubs by 1980 is summarized in Table 1. The FAA is continuing this effort with the publication of its forecasts for medium hubs in late 1968.

FAA methods for forecasting facility requirements were included in the document. One of the derivations used for planning passenger terminal buildings that may have significance for airport access planning is that of typical peak-hour passengers (TPHP). This term represents the total of the highest number of passengers enplaning and deplaning during the busiest hour of a busy day in a typical week. Thus, TPHP represents a plane of high activity but not necessarily the absolute peak number of passengers that could be expected during a given day of the year. The following ratios from data surveys of airports throughout the United States may be used to estimate TPHP:

Total Annual Passengers	TPHP as a Percent of Annual
20,000,000 and over	0.030
10,000,000 to 19,999,999	0.035
1,000,000 to 9,999,999	0.040
500,000 to 999,999	0.050
100,000 to 499,999	0.065
Under 100,000	0.120

Table 2 shows the number of annual passengers (enplaning plus deplaning) during 1965 and forecasts for the years 1970, 1975, and 1980. Table 3 shows the TPHP for the same airports and years obtained by using the given ratios.

CHARACTERISTICS OF AIRPORT-ORIENTED TRAVEL

As shown in the preceding section, air travel has grown at a phenomenal pace. Based on forecasts of future activity, this growth will continue at an accelerated rate. This occurrence can be evidenced by an estimate of 1975 total air passengers, a threefold increase over the 1967 level.

With the introduction of new aircraft and improved flight technology, flight times have been significantly reduced. Accordingly, the airline users, both travelers and shippers, will expect similar improvements in the ground access time—both to and from the airport—to provide an efficient and swift movement between the origin and ultimate destination of a particular trip. Thus, the success of the air-ground transportation system will depend on its ability to collect and distribute passengers consistent with advances achieved by subsonic and supersonic transport. Total trip time will be the measure of an effective transportation system. The gains achieved by the reduction of air travel time must not be offset by increased ground time.

TABLE 1

LARGE HUB AIRPORT AVIATION ACTIVITY AND SELECTED AIRPORT FACILITY REQUIREMENT FORECASTS THROUGH 1980

Airport Aviation Activities	1965	Percent	1980	Percent	Percent Increase 1965-80
Aircraft Operations (millions)	20.3	100	74.6	100	269
Scheduled air carrier	3.8	19	9.1	12	143
General aviation	15.9	78	65.0	87	309
Military	0.6	3	0.5	1	(-21)
Enplaned Passengers (millions)	69.5	100	370.6	100	433
Air carrier	62.8	90	339.2	91	440
Domestic	57.8	83	311.9	84	440
International	5.0	7	27.3	7	445
General aviation	6.7	10	31.4	9	367
Scheduled Air Carrier Cargo Tons (millions)	1.3	100	19.7	100	1,371
General Aviation Based Aircraft (thousands)	20.3	100	50.0	100	146
Less than 12,500 lb	16.0	79	35.3	71	121
More than 12,500 lb	4.3	21	14.7	29	242

Selected Airport Facilities	1980 Requirements
Air Carrier	
Passenger gate positions	2,253
Cargo gate positions	521
Public vehicle parking area (sq yd)	11.5 million
Terminal building area (sq ft)	52.3 million
Cargo building area (sq ft)	7.9 million
Terminal apron area (sq yd)	19.4 million
Cargo apron area (sq yd)	4.4 million
General Aviation	
Public vehicle parking area (sq yd)	3.3 million
Terminal building area (sq ft)	33.5 million
Aircraft apron parking area:	
Hangars (sq yd)	22.1 million
Open (sq yd)	45.3 million

TABLE 2

SCHEDULED AIRLINE PASSENGERS AT 28 AIRPORTS SERVING LARGE HUBS, 1965-1980

Airport	Passengers Enplaned and Deplaned (thousands)			
	1965	1970	1975	1980
Atlanta	6,694	13,874	23,736	40,066
Boston	5,170	9,537	16,316	27,541
Chicago				
O'Hare	17,336	29,736	47,178	81,356
Midway	58	2,238	5,534	10,990
Cincinnati	1,580	3,318	5,676	9,581
Cleveland	3,068	5,610	9,598	16,201
Dallas-Ft. Worth	5,110	9,917	16,964	28,637
Denver	3,010	5,881	10,062	16,985
Detroit	3,670	6,696	11,456	19,366
Houston	2,430	4,489	7,680	12,962
Kansas City	2,412	4,434	7,586	12,804
Las Vegas	1,722	4,070	6,600	11,286
Los Angeles	12,058	21,820	37,276	62,866
Miami	5,558	10,564	18,072	30,510
Minneapolis-St. Paul	2,640	4,886	8,360	14,110
New Orleans	2,236	4,180	7,152	12,073
New York				
Kennedy	14,196	24,790	42,416	71,590
LaGuardia	4,324	8,672	15,002	25,314
Newark	4,574	8,514	14,562	24,570
Philadelphia	3,284	6,134	10,495	17,715
Pittsburgh	3,306	6,122	10,474	17,681
Seattle-Tacoma	2,250	4,360	7,850	13,234
San Francisco-Oakland				
San Francisco	6,680	12,834	17,198	27,690
Oakland	1,468	2,628	9,260	16,970
St. Louis	2,908	5,489	9,392	15,852
Washington-Baltimore				
National	6,348	10,000	10,000	10,000
Dulles	780	2,600	10,312	23,223
Friendship	1,584	3,413	7,325	12,802

TABLE 3

TYPICAL PEAK-HOUR PASSENGERS AT 28 AIRPORTS SERVING LARGE HUBS, 1965-1980

Airport	Typical Peak-Hour Passengers			
	1965	1970	1975	1980
Atlanta	3,374	6,243	9,494	14,023
Boston	2,585	4,678	7,342	11,016
Chicago				
O'Hare	7,801	11,894	16,512	28,475
Midway	116	1,119	2,767	4,946
Cincinnati	790	1,659	2,838	4,790
Cleveland	1,534	2,805	4,799	7,290
Dallas-Ft. Worth	2,555	4,958	7,634	11,455
Denver	1,505	2,940	4,528	7,643
Detroit	1,835	3,348	5,155	8,715
Houston	1,215	2,244	3,840	5,833
Kansas City	1,206	2,217	3,793	5,762
Las Vegas	861	2,035	3,300	5,079
Los Angeles	5,426	8,728	13,047	22,003
Miami	2,779	4,754	8,132	10,678
Minneapolis-St. Paul	1,320	2,443	4,180	6,350
New Orleans	1,118	2,090	3,576	5,433
New York				
Kennedy	6,388	9,916	14,846	25,056
LaGuardia	2,162	4,336	6,751	10,126
Newark	2,287	4,257	6,553	9,828
Philadelphia	1,642	3,067	4,723	7,972
Pittsburgh	1,653	3,061	4,713	7,956
Seattle-Tacoma	1,125	2,180	3,925	5,955
San Francisco-Oakland				
San Francisco	3,340	5,775	7,739	11,076
Oakland	734	1,314	4,630	7,636
St. Louis	1,454	2,744	4,696	7,133
Washington-Baltimore				
National	3,174	4,500	4,500	4,500
Dulles	624	1,300	4,640	9,289
Friendship	774	1,706	3,662	5,761

The impact of the ground travel time problem on air travel is further demonstrated in studies conducted by Peter G. Nordlie. Based on an analysis of data of the 50 most heavily traveled city-to-city air routes in this country, Dr. Nordlie found that the traveler must expect to spend more than 50 percent of his trip time in the short-haul range, traveling only 11 percent of the trip distance. Studies in the long-haul range indicated that the traveler must spend over 20 percent of his time covering only 2 percent of the distance. Thus, it is immediately evident that considerations should be given to imaginative and innovative solutions to keep pace with future demands.

Before serious consideration is given to the development of new approaches, the investigation of exotic hardware, and the formulation of new programs, the various dimensions of ground access should be identified. Identification of these characteristics will provide insight into the unique components of airport travel and form the framework upon which various solutions may be investigated.

A discussion of the characteristics of airport-oriented travel could easily provide the basis of an informative paper in itself. However, an attempt will be made within the scope of this paper only to summarize several pertinent factors, documented in existing studies and reports, that directly affect the dimensions of airport travel. These factors are stratified into the following categories:

1. Trip purpose
2. Travel distribution (geographic and time)
3. Travel mode

Because this stratification is not meant to be all-inclusive, omission of other pertinent factors certainly does not imply a minor role in consideration of ground access to airports.

Trip Purpose

Airports have a special significance in transportation in that they constitute points of transition between intercity and intracity travel and between air and ground modes of travel.

Over the past several years, air transportation has experienced one of the fastest growth rates of any industry, resulting in its emergence as a major force in shaping the development of communities, due to its unique role as an attractor of diverse activities.

Various types of travel demands are focused on the airport complex. Ground travel to and from airports involves more than that of the air traveler and his following—including meeters, greeters, and suitcase carriers. In addition to serving air travel demand, the airport site is also the center for major employment and commercial activity. Another unique function is its attraction for sightseers and tourists for recreational purposes. These activities necessitate increasing recognition of the airport as a major traffic generator.

Typical trip purposes of airport-oriented travel are illustrated by the data given in Table 4 for the San Francisco Airport for an average weekday in July 1967.

It is readily apparent from these data that employment generates a significant portion of airport-oriented travel—slightly less than one-third in the case of San Francisco. Although not shown in Table 4, the 39,250 air-related travel person trips are actually composed of two distinct categories—53 percent attributed to air passengers and 47 percent generated by persons meeting, greeting, or delivering airline passengers.

The remaining category of trips, which accounts for 10 percent of the daily trip-making not particularly related to air travel or employment, includes social and recreational trips such as sightseeing,

TABLE 4

OUTBOUND PERSON TRIPS AT SAN FRANCISCO INTERNATIONAL AIRPORT

Purpose	Number	Percent
Air travel	39,250	60
Employment	19,350	30
Other	7,250	10
Total	65,850	100

TABLE 5

PURPOSE DISTRIBUTION OF PERSON TRIPS TO SELECTED AIRPORTS

Airport	Trip Purpose (percent)		
	Work	Social-Recreational	Air Travel
Atlanta	67.8	5.8	26.4
Buffalo	23.3	33.7	43.0
Chicago Midway	34.7	25.7	39.5
Minneapolis-St. Paul	46.8	19.7	33.6
Philadelphia	24.2	32.8	43.1
Pittsburgh	43.0	20.6	36.5
Providence	39.8	37.7	22.5
San Diego	45.9	21.6	32.4
Seattle-Tacoma	35.0	24.2	40.8
Washington National	69.8	15.8	14.4

dining, and other business related to commercial activities at the airport. The figures are based on July 1967 levels of activity including 35,000 daily air passengers and 21,000 employees, of which 3,000 are nonairline workers—employed by other tenants such as government agencies and retail and commercial establishments.

A 1966 study conducted at Seattle-Tacoma International Airport indicated that air-related trips, including those made by air passengers and persons delivering or meeting air passengers, accounted for 49 percent of the total vehicle trips. Work trips accounted for 40 percent while miscellaneous purposes such as social and recreational trips were 11 percent of the total.

Although the purpose distribution illustrated for both the San Francisco and Seattle-Tacoma airports indicates similar patterns, the distribution varies considerably, as shown in Table 5, and is dependent on the varying levels of activity at that particular site.

Knowing the purposes for which airport travel is generated, the next logical question regards the travel distribution of these trips—both geographic and time.

Travel Distribution—Geographic

Although the central area of any particular city may generate a higher proportion of airport trips, results from numerous studies indicate that origins and destinations are geographically dispersed. On an average weekday in 1967, approximately 15 percent of all air passengers at the Philadelphia airport either originated from or were bound for the central business district (CBD). Similarly, for an average weekday in 1967 in San Francisco, approximately 9 percent of the 66,750 outbound person trips were destined to the CBD. However, remaining trip destinations are widely dispersed.

An air travel study conducted in 1965 by the Indianapolis Regional Transportation and Development Study indicated that approximately 9 percent of the total daily person trips generated within the study area and destined for the airport originated in the CBD. A familiar pattern is repeated in that concentrations of origins are evident in the vicinity of the airport. These are primarily work trips generated by employees of the airport authority, airlines, and various airport concessions.

On an October weekday in 1964, 61,000 passengers arrived at or departed Chicago O'Hare Airport on 1,500 scheduled flights. Slightly less than half (49 percent) of these passengers were transferring planes or flying through. One-third of the remaining 32,000 air passengers using ground transportation had an origin or destination in the central area of the city. The remainder were distributed throughout the Chicago area.

Travel Distribution—Time

An analysis of the time distribution of airport trips indicates that definite hourly patterns exist that vary by trip purpose.

Employee or work trips mirror the characteristic pattern of most employment sites having peak movements at the end of each shift, with major movements occurring between 7 and 9 a.m. and 4 and 6 p.m., including a lesser peak around midnight.

An aircraft maintenance center such as Minneapolis-St. Paul is characterized by three peak periods that tend to attract nearly equal numbers of work trips, as contrasted to other airports such as Washington National where office employment creates a sharp morning peak.

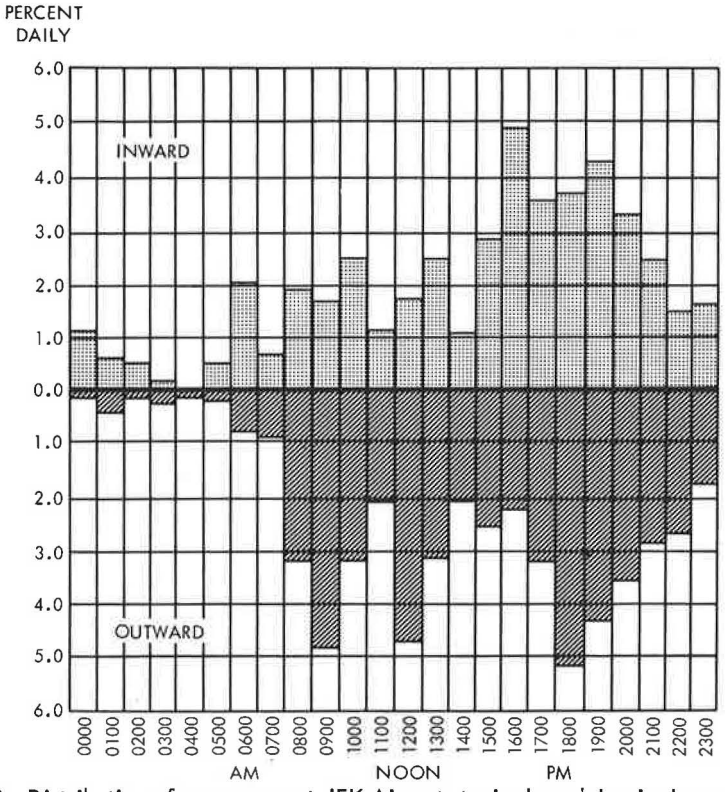

Figure 3. Distribution of passengers at JFK Airport, typical weekday in January 1967.

Air-related trips to the airport usually reach a peak in the late afternoon and evening hours similar to the pattern shown in Figure 3, a plot of inward and outward passenger movements at John F. Kennedy Airport in New York. However, this pattern may vary for different airports where peak periods are also experienced during morning hours. An indication of this variation is given in Table 6, which lists the hour at which the highest percentage of total daily movements occurs.

TABLE 6

PEAK-HOUR AIRCRAFT MOVEMENTS

Airport	Date[a]	Total Daily Movements	Percentage of Movements During Peak Hour	Peak Hour
Cleveland	1966	424	7.5	2000-2100
New York				
Kennedy	1965	978	8.5	1600
LaGuardia	1965	398	7.5	1800-1900
Newark	1965	462	8.0	2100-2200
Norfolk	1965	80	11.3	1900-2000
Palm Beach	1966	58	12.1	2100-2200
Philadelphia	1965	380	10.0	1600-1700
Portland	1966	198	8.1	1600-1700
Richmond	1966	78	11.5	0800-0900
Salt Lake City	1966	150	10.7	1200-1300
San Diego	1965	515	10.0	
San Francisco	1965	572	7.0	1900-2000
Oakland	1965	114	13.2	0700-0800
Seattle-Tacoma	1966	206	10.7	1700-1800
Spokane	1966	68	13.3	0800-0900
Washington				
National	1967	704	6.8	1700-1800
Dulles	1967	118	11.0	1800-1900
Minneapolis-St. Paul	1966	258	7.8	1800-1900
Los Angeles	1966	942	6.6	2000-2100
Atlanta	1966	654	9.8	1000-1100
Asheville	1966	50	12.0	1100-1200
Allentown	1967	46	13.0	0700-0800

[a]All studies were conducted during the month of August.

On the other hand, the occurrence of peak-hour air travel may not necessarily coincide with peak-hour ground travel generated by the combination of all activities at the airport, as shown in Figure 4 for San Francisco.

At many airports, much of the increase in air traffic has occurred during off-peak periods, tending to level out the traffic demands throughout the entire day rather than concentrating them in a few hours. At the Seattle-

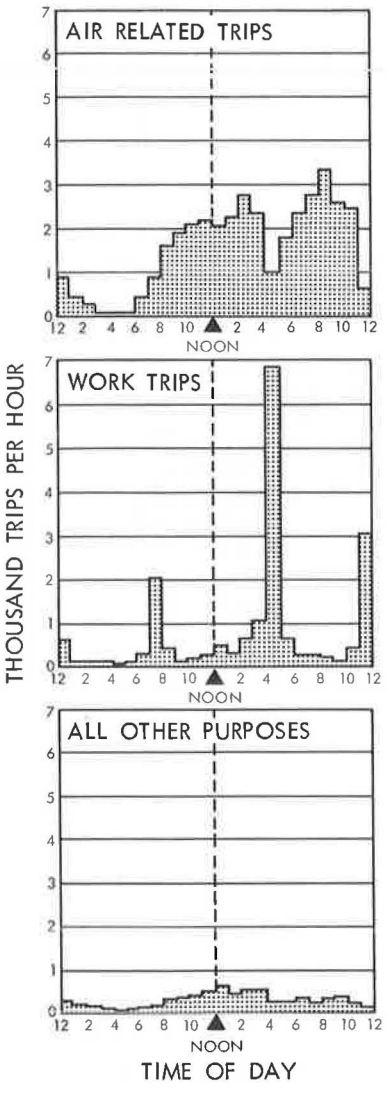

Figure 4. Time distribution of person trips by purpose leaving San Francisco Airport.

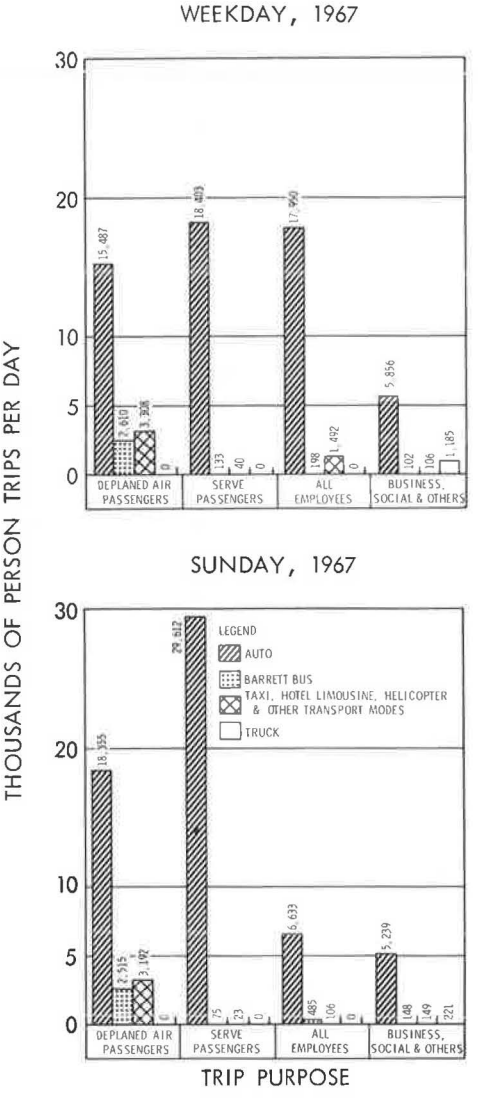

Figure 5. Mode of departure from San Francisco Airport with relation to trip purpose.

Tacoma Airport, peak-hour volumes of enplaning passengers ranged from 9 to 11 percent of the total daily passenger volumes in the early 1960's. In 1966, approximately the same number of enplaning passengers were being handled in the peak hour, but they represented 6 to 7 percent of the total daily passengers. The introduction of a new generation of aircraft in the 1970's with large passenger capacity can be expected to increase peak-hour demands again.

Mode of Travel

The dominance of the automobile as the major mode of transportation for airport-oriented ground travel is clearly evident based on data from numerous areas. In San Francisco, for example, 86 percent of 67,000 person trips departing from the airport on a weekday in 1967 used the automobile as the mode of travel. The predominant use of the automobile was apparent for all trip purposes, as shown in Figure 5.

Data from a survey at the Philadelphia International Airport for a typical weekday in 1967 indicated 50 percent of the person trips to and from the airport used private automobiles, while 10 percent used rental cars. In addition, one-third of the passengers to and from the airport used public transportation, which included 17 percent by taxi, 13 percent by limousine, and 2 percent by bus.

A 1967 summary in the New York area indicated that a significant number of person trips to the New York airports were made on public transportation, as given in Table 7.

TABLE 7

MODE OF AIRLINE PASSENGER TRAVEL TO NEW YORK AIRPORTS

Mode	Kennedy (percent)	LaGuardia (percent)	Newark (percent)
Airport bus/limousine	20	12	25
Helicopter	2	—	1
Commercial	—	—	10
Subway-bus	3	3	—
Taxi	29	47	10
Private automobile	46	38	54

IMPACT OF AIR DEMAND ON HIGHWAY ACCESS

Although airport accessibility is only one element in the problem of overall development of urban transportation, it is a major problem for air travelers and others making trips for numerous reasons including work. In many areas, the parking characteristic of airport-oriented travel is such that it coincides with peaks of areawide traffic, resulting in competition for travel on available facilities. The problem is increasing since fixed facilities are not keeping pace with growth in air traffic and other activities at the airport site.

Although the airport can be considered as a major generator of traffic, its impact on the transportation system may be relatively small when considered in terms of travel by airport traffic in contrast to total areawide travel. However, the impact becomes significant when considered in terms of traffic on the access roads in the vicinity of the airport that funnel traffic to a concentrated point at the airport complex.

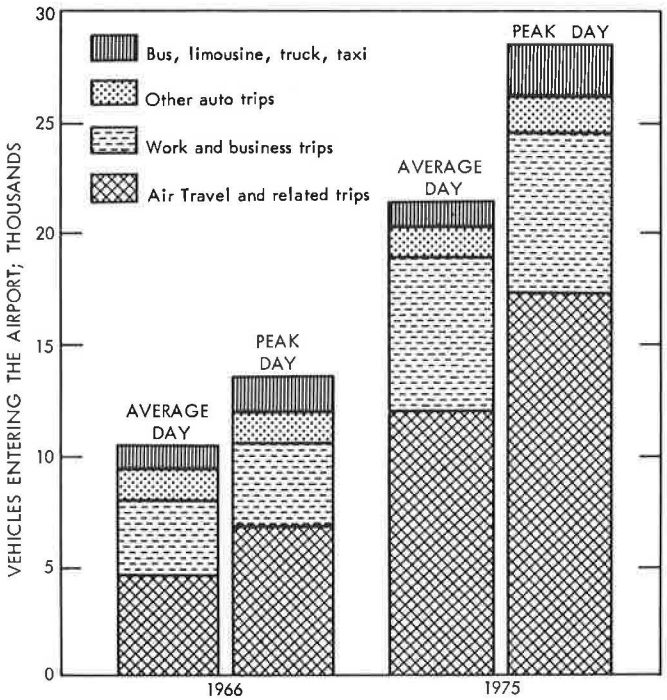

Figure 6. Traffic comparison at Seattle-Tacoma International Airport—1966 and 1975.

The impact of air travel on highway facilities can be illustrated at Los Angeles International Airport. In planning the potential traffic, it was determined that the airway capacity is 80 million annual passengers if there is a maximum development of runway capacities. In addition, with a 65 percent load factor, the loading gate system can be expanded to handle 80 million annual passengers. An analysis of the Airport's internal roadway system indicates that it can handle a maximum of only 56 million passengers. When the parking system that must serve the roadway system is analyzed, further reduction to 53 million passengers is determined. As the external roadway system is analyzed, a critical restraint to airport development is discovered, in that ground transportation can accommodate only 40 million passengers per year into the central airport.

The impact of air travel on airport access facilities can also be illustrated in the case of the Seattle-Tacoma International Airport, as shown in Figure 6, which compares vehicles entering on both an average and peak day. Although only a slight increase is projected for vehicles entering for work and business trips in 1975 as compared with 1966, a significant increase is indicated for air travel and related trips during the same period.

On the other hand, forecasts for the San Francisco International Airport indicate a substantial increase in employment level—from 21,000 in 1967 to 33,000 in 1971—that will generate additional airport traffic. At the same time, daily air passengers will increase from 35,000 to 50,000 in 1971, further compounding the access situation.

A relationship between daily inbound vehicles and daily enplaned passengers is given in Table 8. The ratio varies from 1.68 at Phoenix to 2.76 at Seattle-Tacoma. The higher range of ratios reflects trips for other activities at the airport site in addition to trips relating to air passengers.

FAA-FHWA AIRPORT ACCESS COORDINATION

Coordination between federal airport and highway programs goes back several years. Until 1966, however, coordination mainly involved maintenance of highway clearances to ensure safe movement of air and highway traffic.

As a direct result of discussions between the Federal Aviation Administration and the Bureau of Public Roads concerning increased congestion on airport access routes, in October 1966 BPR issued a circular memorandum to its regional and division engineers. This circular placed increased emphasis on the provision of adequate access to airports that, as major generators, warrant particular consideration in the planning process undertaken by urban transportation studies in compliance with the 1962 Federal-Aid Highway Act. In order that airport needs might be properly identified, the technical

TABLE 8

DAILY INBOUND VEHICLES PER ENPLANED PASSENGER

Airport	1966 Enplaned Passengers (annual)	Inbound Traffic Volume Estimates	Inbound Vehicles per Enplaned Passenger (daily)
Los Angeles	6,015,463	42,000	2.55
Washington National	3,726,926	15,980	1.56
Boston	2,920,517	15,000	1.88
Philadelphia	1,978,263	9,925	1.83
Pittsburgh	1,956,228	9,900	1.85
Denver	1,895,534	12,500	2.41
St. Louis	1,793,628	11,400	2.32
Minneapolis-St. Paul	1,596,915	10,400	2.38
Seattle-Tacoma	1,286,209	9,725	2.76
Baltimore Friendship	1,040,996	5,020	1.76
Phoenix	889,956	4,100	1.68
Washington Dulles	487,056	2,690	2.01

committees for those urban studies in which travel to and from airports is a significant factor have been expanded to include representatives from FAA and managers of local airports. The role of the transportation studies is viewed as a phase of the long-range program that will develop the future transportation needs of urban areas giving due consideration to airport access.

The FAA issued companion instructions to its field offices directing its personnel to (a) take the initiative in contacting BPR division engineers, (b) bring each important airport access problem to the attention of the appropriate division engineer as soon as it became manifest, and (c) participate actively on the technical committee of each urban transportation study.

Subsequently the FAA, in its new directive to field offices on the subject of airport site selection issued in 1967, required BPR coordination on each new airport prior to final site selection and FAA endorsement.

In September 1967, the Secretary of Transportation announced a new 4-point highway program to help solve the problems of airport access and highway congestion. In announcing the program, Secretary Alan S. Boyd said, "Because of past involvement and existing authority, the Federal Highway Administration is in a position to accomplish significant results in a relatively short period of time. The administration's continuing program can place high priority emphasis on improvements in those areas where the airport access problem is most pressing."

His new program includes the following points:

1. Expanded planning to include special consideration of airport access as an essential element of the urban transportation planning process. Such planning coordination is already under way in urban areas where 72 of the nation's most active airports are located.
2. Identification of highway networks serving local airports that are included in the federal-aid highway system. This will allow state highway departments to seek federal participation in needed airport access highway improvements.
3. Evaluation on a case-by-case basis at field level, in cooperation with state highway departments and the Federal Aviation Administration, of the extent of airport access highway problems. This will allow prompt consideration of highway access alternatives and expedited programming of projects within fund allocations.
4. Emphasis on the advantages of the traffic operations program to improve capacity and safety (TOPICS). This program provides federal funds for specific urban highway improvements. The funds could be directed toward connecting airport access roads with a community's supporting highway network, thereby providing access to the downtown area.

TABLE 9

HIGHWAY ACCESS TO AIRPORTS—LARGE HUBS

Hub	Airport	CBD	Distance (mi)		Descrip. of Maj. Rt. Miles	Avg. Travel Time (min.)				Travel Speed (mph)				Public Transportation
						Maj. Rt.		Alt. Rt.		Maj. Rt.		Alt. Rt.		
			Maj. Rt.	Alt. Rt.		Peak	Off-Peak	Peak	Off-Peak	Peak	Off-Peak	Peak	Off-Peak	
w York, N.Y./ wark, N. J.	Kennedy International	Manhattan	14.3	13.2	I: 7.0	50.0	30.1	68.5	54.8	17.2	28.5	11.5	14.5	Taxi, airport coach, subway, bus, helicopter
w York, N.Y./ wark, N. J.	LaGuardia	Manhattan	7.8	10.7	I: 6.8 FAP: 1.0	31.5	19.1	34.0	23.6	14.9	24.4	18.9	27.2	Taxi, airport coach, subway, bus, helicopter
w York, N.Y./ wark, N. J.	Newark	Manhattan	11.0	13.5	I: 10.4 Other: 0.6	23.7	15.9	48.9	24.2	27.8	41.5	16.6	33.5	Taxi, airport coach, bus, helicopter
iladelphia, ./Camden, J.	Philadelphia International	Philadelphia	8.9	7.7	I. 4.1 FAP: 4.8	24.0	20.0	26.0	21.0	22.0	27.7	17.8	22.0	Taxi, limousine, bus
iladelphia, ./Camden, J.	Philadelphia International	Trenton	41.5	50.1	FAP: 37.3 Other: 3.2	76.0	—	73.0	—	33.0	—	40.0	—	Taxi, limousine, bus
iladelphia, ./Camden, J.	Philadelphia International	Camden	12.4	12.5	I: 5.1 FAP: 5.3 Other: 2.0	30.0	27.0	33.0	29.0	24.8	27.6	21.7	25.8	Taxi, limousine, bus

A continuing liaison between the headquarters elements of FHWA and FAA was established in November 1967 for the specific problem of airport access. A free flow of in-house directives of both administrations was initiated, along with quarterly reporting systems designed to alert both headquarters of the results of successful field coordination, as well as known problem areas.

To provide a comprehensive analysis of the level of service being provided the airports, BPR and FAA field offices working cooperatively with state highway departments have furnished detailed information on the adequacy of routes serving airports. This information includes functional classification of the highways, peak and off-peak travel times between CBD and airport, and average speeds and distance. This information will identify those routes or sections that are in most urgent need of improvement. Table 9 is an example of the type of information collected in this study.

Considerable effort has been expended in this coordination program. The coordination effort is being expanded to include contact with such interested groups as the American Transportation Association, Air Transport Association, and the Airport Operators Council International to inform them of the program and to request support.

Future efforts will concentrate on the planning and programming of long-range improvements to serve the airport's needs for the next several decades.

SUMMARY

With the dispersal of origins and destinations of airport-oriented traffic throughout urbanized areas, highway networks will continue to provide the principal access to airports in the foreseeable future. Thus, the automobile, with its flexibility and convenience, will remain as the primary mode using the highway facility in serving the scattered trip ends. It then becomes apparent that emphasis should be directed toward the improvement of existing access facilities in addition to construction of new facilities to maintain pace with increased air demands. Needless to say, such action will certainly improve the service of the other members of the rubber-tired family, such as taxis, limousines, and buses, that primarily provide service to concentrated areas o. airport-oriented traffic. In addition, the possibility of other existing modes of access, such as extension of rapid rail transit and the use of helicopter service, certainly should not be excluded in any considerations of existing access modes.

Several interesting approaches have recently been investigated using existing modes of airport access. A freeway for the exclusive use of buses between downtown Kansas City and the airport is being studied. Consideration will also be given to the possible use of the right-of-way by other forms of rapid transit. Completion of the extension of the rapid transit system in Cleveland will make that city the first in the United States with a rapid rail link between downtown and the airport terminal. In addition to 5,300 parking spaces provided at seven rapid rail stations along the existing line, two new intermediate stations on the 4-mile extension will each have parking for approximately 1,250 vehicles. It is estimated that 8 percent of the 4 million annual passengers carried on the extension will be airline passengers.

The possibility of new and sophisticated hardware, currently in various stages of development, provides unique and encouraging proposals for access to airports, including the following:

1. A demonstration project using the hovercraft or air-cushion vehicle was conducted in San Francisco carrying passengers over the bay between the airport and downtown.
2. A feasibility study of the skylounge was recently conducted in Los Angeles. The system consisted of a lounge towed by a vehicle that collected passengers at various downtown points. The lounge was subsequently towed to a heliport where it was transported by helicopter to the airport and again towed to the terminal.
3. Much potential exists for the use of vertical or short-takeoff and landing (V/STOL) aircraft.
4. The feasibility of using bimodal or bus-rail vehicles is under study by the Port of New York Authority. Such vehicles would use existing highway facilities in down-

town Manhattan and in the vicinity of the Kennedy Airport with the intervening portion of the journey using railroad trackage.

In many areas, hardware alone will not fully answer the needs of an efficient access system. Rearrangements of airport functions may provide improvements even with the use of available technology. For example, an idealized concept for a future airport complex to serve a large metropolitan area is shown in Figure 7. Although the concept is applicable to the large hubs, several of the functions could be served by an airport in a smaller hub. Modification of such an idealized concept must be made to specific areas to account for current conditions as well as differences in economic and geographic characteristics of the area.

The elements of the concept shown in Figure 7 are as follows:

1. International—A major air carrier airport serving a large metropolitan area to connect it with comparable areas, both foreign and domestic; designed for supersonic as well as subsonic large-capacity jets.
2. Domestic long-range—A major air carrier airport serving a large metropolitan area to connect it with comparable and smaller areas within the conterminous United States; designed for subsonic large-capacity jets (long-range is considered to be over 750 miles).
3. All cargo—A major air carrier airport strategically located within a metropolitan area to serve industrial concentrations; connects metro area to similar facilities in comparable areas.
4. Short-range shuttle/commuter—An airport located reasonably near the CBD of a metropolitan area to furnish direct flights to similar or larger airports in other metro areas (short-range is generally considered to be less than 750 miles).
5. V/STOL—An airport located at the CBD designed to accommodate short-haul V/STOL transport aircraft; primary service is from CBD to outlying air commerce airports and to nearby CBD's for daily commuter service.
6. Heliport—A landing facility for vertical takeoff and landing aircraft; located at population and industrial concentration as well as CBD's and major airport to furnish intrametro area connections.
7. General aviation airport—An airport used solely by general aviation aircraft for activities such as air taxi, business, commercial, and personal flying.

Other elements of the system are rapid transit connecting the major air carrier airports to each other and to the CBD, rail connections from the CBD to the cargo airport, and adequate freeway and highway access to all landing facilities in the system.

Of course, only the very largest metropolitan areas could have the requirement for each of the individual functional airports. In most cases, an airport will serve more than one of these functions.

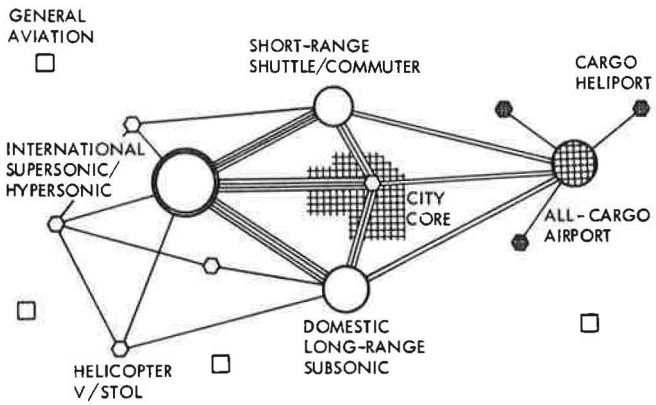

Figure 7. Concept for future airport complex (3).

Underlying the complex problem of providing adequate access to airport-oriented traffic, the definite need for effective planning based on sound data is quite evident. Therefore, it becomes important that airports, as special generators of traffic, should be accorded particular consideration in all comprehensive transportation planning studies in order to vigorously define the access problem and to provide the basis for effective solutions. In many areas, special airport studies have been conducted in which airport travel patterns have been identified, and the impact of these patterns on existing and future access analyzed. With the increased level of air demand, the need for the combined effort of those engaged in planning to provide efficient, safe, and convenient access at reasonable costs becomes quite evident.

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1. Only 16 percent of all air travelers had a trip origin or destination in downtown Philadelphia; more than 80 percent of the air travelers were going to other points in the Delaware Valley.
2. About 70 percent of the air travelers were on company business, with pleasure trips as the next highest category at 14 percent.
3. Private automobile was the predominant mode of access to the airport—half the air travelers arrived by private car, with another 10 percent using rental cars. Downtown Philadelphia generated more "common carrier" traffic than the total of all other segments of the region.
4. Male air travelers outnumbered females by better than 4 to 1; approximately 75 percent of the male air travelers were on company business, while the largest category of females was 44 percent who made pleasure trips.
5. Approximately 70 percent of air travelers checked at least one bag.
6. Airport employees also showed a scattering of origins: 44 percent were from the City of Philadelphia and 34 percent from Delaware County. Almost 9 out of 10 airport employees traveled to work by private automobile.

A simulation of 1992 airport traffic on the projected access facilities, including the Regional Interstate Freeway network, indicates that the access road design will permit free flow of future traffic with no external congestion. Designs have been developed to be not only structurally feasible but, more importantly, to provide the motorist with sufficient decision time to make choices among the three possible roadways—enplaning, deplaning, or parking. Traffic volumes have been analyzed for the critical weekday peak hour for each of these functions. Internal circulation facilities are adequate to handle moving vehicles, and curb space adequacy has also been tested and found sufficient.

DATA COLLECTION

To meet the objective of developing transportation criteria for architectural and engineering planning and to test the adequacy of access routes, parking facilities, and internal circulation, the quantity and location of airport travel were analyzed during November 1967. Field studies included an in-flight origin-destination survey to determine the characteristics of air travelers. (A total of 460 arriving and departing flights were surveyed.) Similar analyses were conducted to obtain information on airport employees.

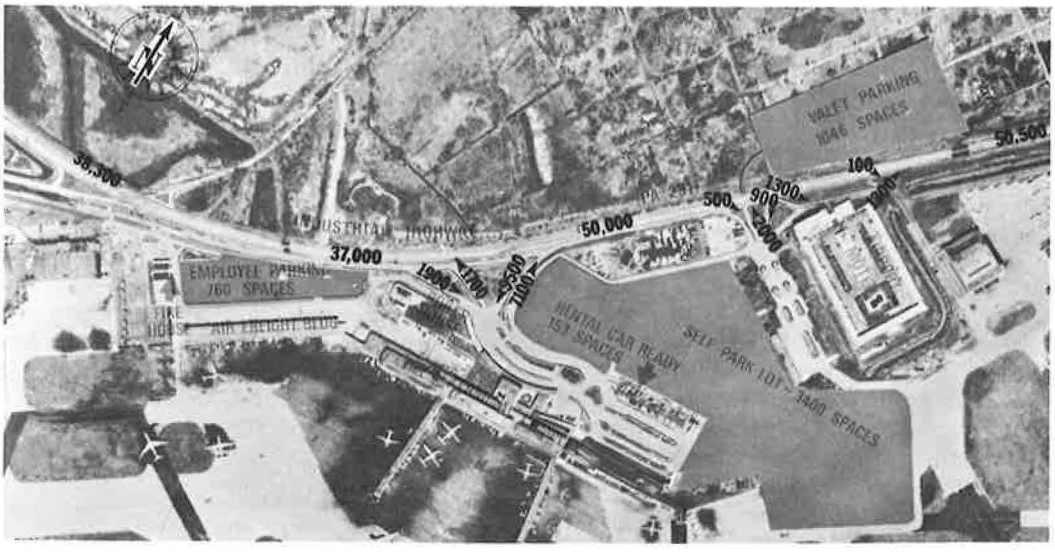

Figure 1. 1967 average weekday traffic and parking lot capacities.