

TCRP

REPORT 62

TRANSIT
COOPERATIVE
RESEARCH
PROGRAM

Improving Public Transportation Access to Large Airports



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TCRP REPORT 62

**Improving Public Transportation
Access to Large Airports**

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in association with

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and

MARKETSENSE
Boston, MA

SUBJECT AREAS

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TRANSIT COOPERATIVE RESEARCH PROGRAM

The nation's growth and the need to meet mobility, environmental, and energy objectives place demands on public transit systems. Current systems, some of which are old and in need of upgrading, must expand service area, increase service frequency, and improve efficiency to serve these demands. Research is necessary to solve operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the transit industry. The Transit Cooperative Research Program (TCRP) serves as one of the principal means by which the transit industry can develop innovative near-term solutions to meet demands placed on it.

The need for TCRP was originally identified in *TRB Special Report 213—Research for Public Transit: New Directions*, published in 1987 and based on a study sponsored by the Urban Mass Transportation Administration—now the Federal Transportation Administration (FTA). A report by the American Public Transportation Association (APTA), *Transportation 2000*, also recognized the need for local, problem-solving research. TCRP, modeled after the longstanding and successful National Cooperative Highway Research Program, undertakes research and other technical activities in response to the needs of transit service providers. The scope of TCRP includes a variety of transit research fields including planning, service configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices.

TCRP was established under FTA sponsorship in July 1992. Proposed by the U.S. Department of Transportation, TCRP was authorized as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). On May 13, 1992, a memorandum agreement outlining TCRP operating procedures was executed by the three cooperating organizations: FTA, the National Academies, acting through the Transportation Research Board (TRB); and the Transit Development Corporation, Inc. (TDC), a nonprofit educational and research organization established by APTA. TDC is responsible for forming the independent governing board, designated as the TCRP Oversight and Project Selection (TOPS) Committee.

Research problem statements for TCRP are solicited periodically but may be submitted to TRB by anyone at any time. It is the responsibility of the TOPS Committee to formulate the research program by identifying the highest priority projects. As part of the evaluation, the TOPS Committee defines funding levels and expected products.

Once selected, each project is assigned to an expert panel, appointed by the Transportation Research Board. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, TCRP project panels serve voluntarily without compensation.

Because research cannot have the desired impact if products fail to reach the intended audience, special emphasis is placed on disseminating TCRP results to the intended end users of the research: transit agencies, service providers, and suppliers. TRB provides a series of research reports, syntheses of transit practice, and other supporting material developed by TCRP research. APTA will arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by urban and rural transit industry practitioners.

The TCRP provides a forum where transit agencies can cooperatively address common operational problems. TCRP results support and complement other ongoing transit research and training programs.

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NOTICE

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The members of the technical advisory panel selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and while they have been accepted as appropriate by the technical panel, they are not necessarily those of the Transportation Research Board, the National Research Council, the Transit Development Corporation, or the Federal Transit Administration of the U.S. Department of Transportation.

Each report is reviewed and accepted for publication by the technical panel according to procedures established and monitored by the Transportation Research Board Executive Committee and the Governing Board of the National Research Council.

Special Notice

The Transportation Research Board, the National Research Council, the Transit Development Corporation, and the Federal Transit Administration (sponsor of the Transit Cooperative Research Program) do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the clarity and completeness of the project reporting.

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FOREWORD

*By Staff
Transportation Research
Board*

This report will be of interest to individuals involved in planning and implementing improved public transportation access to large airports. The dramatic increases in air travel, congestion near airports, and interest in providing rail transit to airports make this a very timely research report.

Under TCRP Project B-18, “Improving Public Transportation Access to Large Airports,” the research team of Leigh Fisher Associates, Matthew A. Coogan, and MarketSense prepared the report. In response to the project objective, the researchers identified strategies to improve public transportation access to large airports through increased awareness of issues and best industry practices.

TCRP Report 62, “Improving Public Transportation Access to Large Airports,” provides a wealth of information about the current status of public transportation services and their use at large airports in the United States and around the world. Chapters 1 and 2 lay the foundation for the report by providing key definitions and by describing the market segments that presently use public transportation to airports. Chapter 1 defines large airports and public transportation services, as a subset of the ground transportation services providing access to airports. Chapter 2 describes travel mode choice patterns and other data for passengers and employees at selected large U.S. and international airports. Key factors affecting passenger and employee use of public transportation for airport access are also presented. Market trends and factors affecting ridership at nine U.S. airports with direct rail service are presented as well as trends and factors at U.S. airports with rubber-tired access systems such as prearranged limousines, shared-ride vans, express buses, and multistop buses.

Chapter 3 presents a market research approach to planning public transportation to airports. This chapter defines the airport ground access market; presents characteristics of the market (including air travelers and airport employees); describes a methodology for airport ground access market research; and presents an application of market research using Boston-Logan International Airport’s ground access program as a case study.

Chapter 4 describes 14 of the most successful airport access systems in the world. The combination of bus and rail services at each of these airports serves more than 20 percent of the air passenger market share. Chapter 5 assimilates the findings from Chapter 4 and presents lessons learned from the successful rail systems. The intent of this chapter is to provide insights for U.S. communities considering improvement in public transportation access to their airports, in particular rail transit services.

Chapter 6 summarizes recent transit industry developments in the following six areas that could affect ground access to airports: advanced traveler information systems, technology for ridesharing, emerging bus technology, emerging rail technology, automated people mover technology, and alternative strategies for off-site airport check-in. Chapter 7 provides an overview of the key legal, financial, institutional, and

jurisdictional factors affecting public transportation to airports. Three major institutional factors affecting financing for airport access projects are described: (1) federal funding and oversight, especially Federal Aviation Administration policies; (2) funding for surface transportation projects by the Federal Highway Administration, the Federal Transit Administration, and state governments; and (3) contractual agreements between airport operators and airlines. Chapter 8 examines implications for further research.

The report includes two unpublished technical appendixes. Appendix A includes data for 38 of the top 40 large U.S. airports, and Appendix B provides descriptions of access systems at selected U.S. airports. The information in both appendixes (which is current as of March 1999 and is summarized in TCRP Report 62) is available upon request from TCRP.

Following completion of TCRP Project B-18, the research team was retained to conduct TCRP Project B-18A, "Improving Public Transportation Access to Large Airports: Phase II." This project will present additional information on rubber-tired public transportation services to airports and will integrate the findings from Phases I and II to provide guidance for planning improved public transportation access to large airports. The results of the Phase II research will be published in the TCRP report series upon completion of the project.

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IMPROVING PUBLIC TRANSPORTATION ACCESS TO LARGE AIRPORTS

EXECUTIVE SUMMARY

This report presents available data on the use of public transportation at large U.S. airports and selected international airports, as well as related evolving trends. The report also presents (1) key factors affecting the use of public transportation by airline passengers and employees; (2) new and emerging technologies that have the potential to improve public transportation services at airports; and (3) barriers to public transportation access to large airports, including FAA and contractual barriers, as well as local regulations and rules.

PROPOSED DEFINITION OF PUBLIC TRANSPORTATION AT AIRPORTS

Alternative definitions of public transportation were considered. For the purpose of this report, public transportation is defined as including (1) rail services; (2) express and multistop buses; and (3) shared-ride, door-to-door vans. These modes are available to the general public and are intended to transport more than one passenger or a small group of passengers traveling together. This definition excludes courtesy vehicles, pre-arranged limousines, charter buses and vans, and taxicabs.

AIRLINE PASSENGER MARKET SHARE DATA AT LARGE U.S. AIRPORTS

Figure S-1 presents public transportation market share data for originating airline passengers (by type of service) for 33 of the 40 large U.S. airports. As shown, airports with largest market shares for public transportation are those serving San Francisco, Boston, and Washington, D.C. As discussed in the accompanying report and highlighted in the following paragraphs, a limited proportion (fewer than 15 percent) of all originating airline passengers now use public transportation to travel to and from most large airports in the United States; some airports are more successful than others. The specific market shares, the trends in these market shares, and the primary factors contributing to the existing patterns are described in Chapter 2.

Eight U.S. airports have direct rail service at the terminal. The airport with the largest proportion of rail ridership is Washington, D.C.'s Reagan National Airport (14 percent).

At both Hartsfield Atlanta International Airport and Chicago Midway Airport, about 8 percent of all originating passengers use rail; 4 percent use rail at Chicago-O'Hare International Airport. Rail service is used by fewer than 3 percent of all originating passengers at the other four airports (Baltimore-Washington, Cleveland Hopkins, Philadelphia, and Lambert-St. Louis International Airports). Only two of the eight airports with direct rail service have total public transportation market shares above 9 percent—Reagan National Airport (18 percent) and Midway Airport (11 percent).

At 11 large U.S. airports, shuttle bus service to rail stations on or near the airport is available. These airports include those serving Boston, Fort Lauderdale, Los Angeles, Miami, Newark, New York (John F. Kennedy International and LaGuardia Airports), Metropolitan Oakland, San Francisco, San Jose, and Washington, D.C. (Dulles International Airport). The airports with largest proportion of rail ridership by originating passengers are Boston-Logan (5.7 percent) and Metropolitan Oakland (4.1 percent) International Airports. Use of rail by originating passengers was 1 percent or less at the other nine airports. At three of these airports, the total public transportation market share is above 8 percent—San Francisco (21.0 percent, the highest of any U.S. airport), Boston-Logan (18.6 percent), and Los Angeles (13.1 percent) International Airports.

In addition to the 19 airports that have direct rail service or a shuttle bus link to rail service, market share data were available for an additional 15 large U.S. airports. At six of these airports the public transportation market share is above 12 percent—San Diego (19 percent), New Orleans (16 percent), Denver (14 percent), Las Vegas McCarran (13 percent), and Seattle-Tacoma (12 percent) International Airports.

Employee market share data were available from seven airports. Private vehicles are the dominant access mode at all the airports where data were available. Employee use of public transportation was reported to be above 10 percent at only two of these airports—Boston-Logan (16.6 percent) and Denver (14.2 percent) International Airports. At the other airports where data were available, employee use of public transportation was reported to be less than 5 percent.

AIRLINE PASSENGER MARKET SHARE DATA AT INTERNATIONAL AIRPORTS

Figure S-2 presents available market share data for 14 international airports with direct rail service. As shown, the new airport serving Oslo had the highest reported use of rail (43 percent) and rail plus bus (63 percent). This market share reflects the policy goal of the airport operator plus the relatively isolated location of the airport. At the new airport serving Hong Kong, which is also relatively isolated, about 24 percent of the passengers are reported to use rail, while 36 percent use bus services.

An important goal of airports with successful rail access services (i.e., those used by more than 20 percent of the originating airline passengers) is to attract a significant proportion of the airline passengers to rail service. As defined in this limited way, U.S. airports have been less successful than some non-U.S. airports in incorporating rail transit as a ground access mode, for reasons described in Chapter 2.

A Market Research Approach to Planning Transportation Services to U.S. Airports

The successful integration of transit (both rail and rubber-tired) as a ground access mode at airports is dependent on several factors, as suggested by successful case studies of public transportation services at airports in the United States and overseas. These

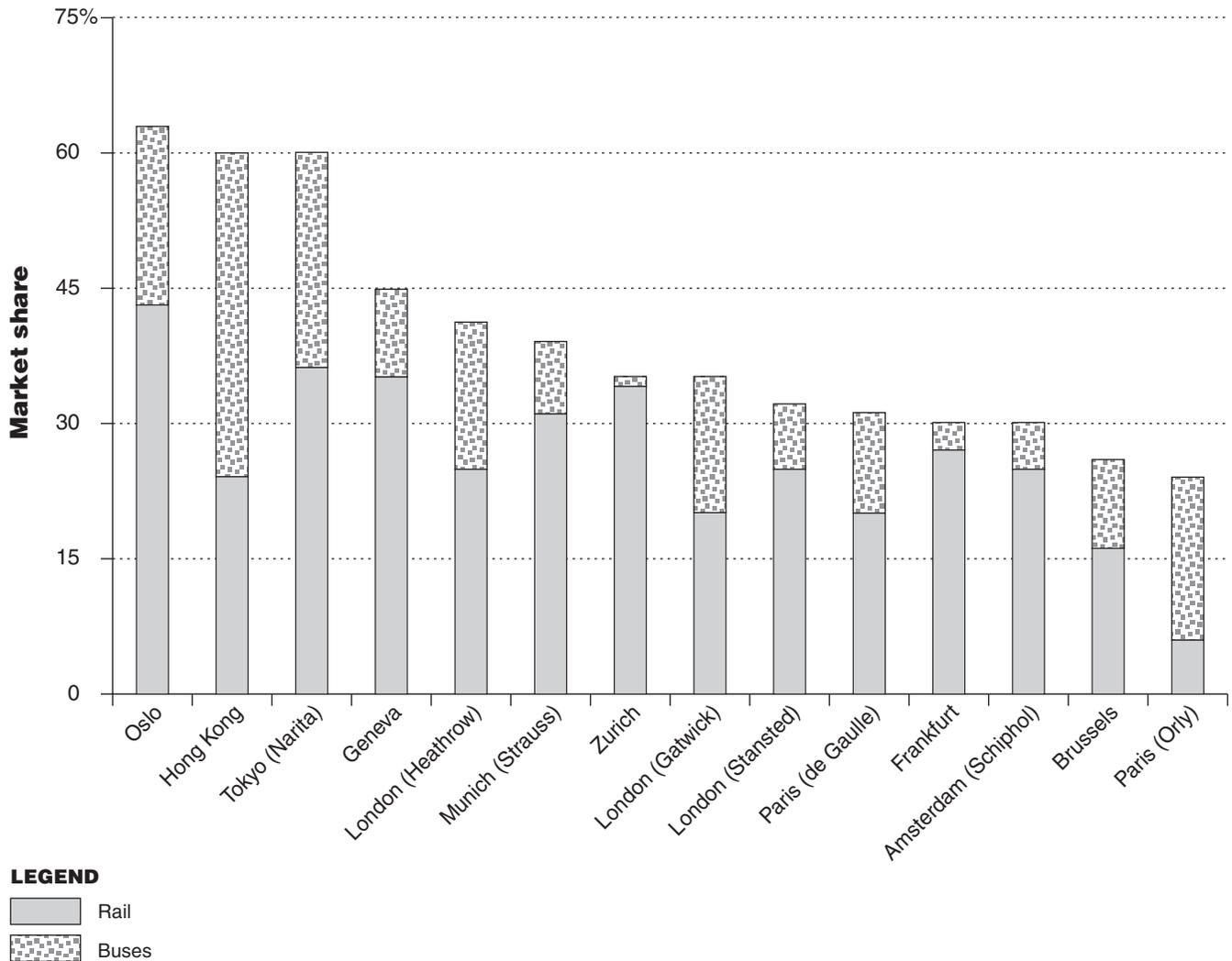


Figure S-2. Market shares of rail and bus at international airports.

SOURCE: Matthew A. Coogan, based on information provided by airport management.

factors include knowledge and understanding of the requirements of the airport user (described in Chapter 3) and incorporation of transportation system design features that respond to customer demands and provide for market segments specific to airport ground access (described in Chapter 5).

Airline passengers and airport employees are the two principal groups of travelers forming the market for airport ground access services. Understanding the needs of these travelers and their access mode choices requires a standardized base of information. Market research provides the mechanism for gathering the needed data and for systematically identifying the characteristics of the market.

Airport ground access travelers can be classified into categories based on a number of market attributes. Two market attributes that have proven particularly useful in describing the differences in airline passenger modal access patterns and needs are passengers' travel purposes (e.g., business versus nonbusiness) and places of residence (e.g., resident of versus visitor to the region). For both airline passengers and airport employees, the geography of the airport market (distribution of ground access

trip origins) is of particular importance in determining the potential use of a ground access mode.

The market for ground access travel is composed of diverse segments, with each segment having different service needs. The degree to which individual ground access modes fulfill the service needs of each segment varies based on the characteristics of the local market. Thus, identifying and understanding the relationship between ground access mode choice and the local market conditions and attributes at an airport provide a foundation for planning new services and enhancing existing services. Using this information can help in designing fixed guideway public transportation targeted to individual segments of the airport ground access market.

Market Factors and Trends at U.S. Airports

Trend data were analyzed for nine airports with rail service. Key factors affecting use of rail service were found to be the

- Relatively small proportion of passengers with trip ends in the downtown area;
- Proportion of airport passengers familiar with regional transit system;
- Differential travel costs and travel times (and travel time reliability) compared to taxicabs, for example;
- Availability of parking both at the airport and at non-airport stations;
- Frequency of service;
- Proportion of passengers with little or no checked baggage; and
- Level of convenience offered at the airport and non-airport ends of the trip. This factor reflects walking distances and number of level changes encountered between the ticket counters and baggage claim areas and the rail station, the need to transfer to another mode (e.g., at Boston-Logan Airport), and the proximity of the station to major destinations in the central business district elsewhere in the region.

Key factors affecting the use of rubber-tired transportation services were found to be the

- Relatively small proportion of airline passengers (or airport employees) with trip ends in the downtown or other areas well served by scheduled rubber-tired transit;
- Competition between the variety of rubber-tired ground access services available at an airport;
- Differential travel costs and travel times (and travel time reliability) compared to other available modes;
- Rules and type of business arrangements that airport operators establish to control and manage ground transportation operations;
- Availability of door-to-door transportation. Because they often value travel time (and convenience) more highly than travel cost, airline passengers are willing to pay for door-to-door services (e.g., shared-ride vans, prearranged limousine services, and taxicabs) rather than ride less expensive multistop or express bus services;
- Need for airline passengers using express or multistop buses to transfer to a second mode or walk a long distance (with baggage) at the non-airport end of the trip;
- Location of the non-airport express bus terminals with respect to regional highways and distance from the airport, the reliability of the service, and differential travel times; and
- Reduced rubber-tired transit service at night and weekends and the availability of free or low-cost parking for employees.

Lessons Learned from Successful Rail Systems

A review was conducted of 14 successful airport rail access systems located in Europe and Asia, each of which attracts over 20 percent of the airline passenger market. The review indicates that there are four key elements or attributes of the rail service associated with these successful airports:

1. *Type of service to the downtown and metropolitan area*—Successful systems appear to either focus on line speed between the airport and downtown (i.e., provide dedicated service) or focus on the quality of the distribution service and headway minimization that results from joint operation with regularly scheduled services. Analyses indicate that an emphasis on door-to-door travel time to a single point may be unproductive because of the typical broad distribution of airline passenger trip ends.
2. *Availability of service to national destinations beyond the metropolitan area*—At several of the most successful airports, the rail connection is designed to link to a full national network (and provide a direct path to major national destinations), rather than to link to just the immediate downtown and surrounding metropolitan area. In several communities, the travel times provided by rail service to nearby national destinations are competitive with those provided by scheduled airlines. It is important, however, to emphasize the large scale of the national rail networks into which the airport access systems have been integrated, because the lack of such rail networks in the United States makes similar strategies infeasible at most U.S. airports.
3. *The quality of the rail connections at the airport*—For a potential rail customer, a key issue is the availability of a seamless connection between the aircraft gate and rail platform, including the ability to easily find the platform, and the required walking distances (excluding the distance with mechanical assistance, such as moving walkways) and number of level changes encountered. Typically airports with a single terminal building are easier to serve with rail than those airports with multiple unit terminals. Most of the airports with the highest rail mode shares have a direct rail connection to a single, centralized point of transfer to a compact landside terminal building. Of the 14 successful airport rail systems, only the 2 airports serving Paris rely on either a bus or an automated people mover to transfer passengers between the rail platform and landside terminal, and both of these airports rank near the lowest in terms of rail market share.
4. *Baggage handling strategies and services, and availability of off-site facilities*—To encourage use of rail service by airline passengers with multiple pieces of checked-bags or large bags, it is desirable to provide for baggage handling. The successful airport rail systems exhibit a variety of responses to this challenge, ranging from doing nothing to developing elaborate, full-service off-site check-in facilities. The report examines full-service downtown check-in counters and national schemes that provide check-in opportunities through the national rail system. While the availability of off-site baggage check-in facilities is a positive attribute, many of the successful systems have achieved high market shares without providing expensive full-service downtown check-in counters or other elaborate strategies. The strategies should be structured to serve the needs of the market (e.g., number and size of bags per airline passenger).

New and Emerging Technologies for Airport Access

Six areas where new or emerging transit industry technologies can improve airport ground access are described. These include the following:

1. *Advanced Traveler Information Systems (ATIS)*—Traveler information is disseminated at (1) the time of trip planning, (2) the time of trip commencement, or (3) while travelers are en route. These measures include real-time or dynamic information systems, integration of ground access information with airline information, and other measures.
2. *Technology for ride matching*—Efforts are under way in Europe and elsewhere to increase taxicab occupancies and provide automated vehicle dispatching.
3. *Emerging bus technology*—Emerging technologies include level entry buses, guided buses, and advanced bus system designs. Other trends include airline operation of bus service.
4. *Emerging rail technology*—Emerging technologies include the design of vehicles used in shared and dedicated airport service (including purpose-built vehicles), high-speed rail, and magnetic levitation technologies.
5. *Automated people mover technology*—Most airport automated people movers are used to transport passengers to and from aircraft gates. Although other systems are being planned or considered, the only existing use of automated people movers to transport passengers off airport property to regional rail connections is the system at Paris Orly International Airport.
6. *Alternative strategies for off-site airport check-in*—Off-site check-in services are provided at several European airports, including those serving Zurich, Geneva, and London (Gatwick and Heathrow), and at Hong Kong International Airport.

Institutional Environment and Factors Affecting Public Transportation Access to Large U.S. Airports

Most of the sources of capital available to finance airport improvements have either direct or indirect external restrictions on their use (i.e., federal or contractual restrictions). These restrictions are described in Chapter 7. Federal regulations provide specific direction to airport operators regarding project eligibility and use of federal funds, airport rates and charges, and the use of airport revenues. Airport–airline agreements in place at many airports also set forth the manner in which rentals, fees, and charges are paid by the airlines for use of the airport. Many airline agreements contain provisions that give the airlines that signed the airport–airline agreement some control over capital investment decisions and long-term financial obligations undertaken by the airport operator.

The principal sources of funds to build airport projects, in order of importance, are as follows:

1. Airport revenue bond proceeds,
2. Passenger facility charge revenues,
3. Federal grants,
4. Internally generated capital retained from airport revenues,
5. Special facility bonds, and
6. State and local grants.

In developing a strategy for funding off airport access projects, it is important to recognize the hurdles uniquely associated with use of each funding source and to recognize the external approval required for each, if any. The specific eligibility requirements for federal Airport Improvement Program (AIP) grant funding for access roads include the need for the facility to be on the airport or right-of-way acquired by the airport operator and for the facility to exclusively serve airport traffic. Eligible rapid transit facilities

must also be within the airport boundary and primarily serve the airport. The availability of airport funds for such facilities is prorated based on the shared use. Eligibility for passenger facility charge funding is identical to AIP eligibility requirements.

Certain airport projects are also eligible for federal grants and credit assistance that are available for surface transportation projects through the FHWA and FTA. There is tremendous demand, however, for those grants. Airport projects must be given high enough priority on a state's Transportation Implementation Program (TIP) to actually receive funding. Because airport projects are often lower in priority given the number of other funding sources upon which airport operators can draw, it is relatively unusual for airport projects to receive federal grants for surface transportation projects.

Two factors affect whether federal-aid funds can be used for airport access: (1) underlying project eligibility, which in most cases is determined by legislation; and (2) funding availability, which depends on the entity that controls use of the funds deciding to use the funds on airport-access projects. That entity is usually the department of transportation in the metropolitan area in which the airport is located, working with the relevant metropolitan planning organization.

On February 16, 1999, the Federal Aviation Administration issued its final policy concerning the use of airport revenue. Major changes in this policy include provisions that allow airport revenues to be used (1) to pay the operating costs of a ground access project; (2) to make airport property available at less than fair market value for public transit terminals, rights-of-way, and related facilities; and (3) to make airport property available to private ground transportation services where publicly owned transit services are limited and provide the primary source of public transportation.

Implications for Further Research

The implications of each chapter on future research directions are discussed, including areas requiring further analysis and areas in which ongoing progress in the transportation industry should be monitored. This report summarizes the results of the first phase of the research project, which had a greater focus on rail service to airports. The second phase, which is now under way, will focus on rubber-tired services and other technologies.

CHAPTER 1

INTRODUCTION

RESEARCH OBJECTIVE

The objective of this research is to define strategies to improve public transportation to large airports through increased awareness of issues and best industry practice.

REPORT ORGANIZATION

This report is organized into eight chapters:

- Chapter 1: Introduction
- Chapter 2: Current Status of Public Transportation Services to Large Airports
- Chapter 3: A Market Research Approach to Planning Public Transportation Service to Airports
- Chapter 4: Examples of Successful Airport Access Systems Around the World
- Chapter 5: Lessons Learned from Successful Rail Systems
- Chapter 6: New and Emerging Technologies for Airport Access
- Chapter 7: Institutional Environment and Factors Affecting Public Transportation Access to Large U.S. Airports
- Chapter 8: Implications for Further Research

Chapter 1 presents the basis for defining, ranking, and selecting large U.S. airports for which available data on the use of public transportation to access the airport were assembled. This chapter also defines various ground transportation terms and the services available at most of these airports.

Chapter 2 describes public transportation market shares and patterns and the status of evolving trends at large U.S. and selected international airports. Factors that affect the use of rail and rubber-tired public transportation services by both airline passengers and airport tenant employees, including business arrangements between airport operators and rubber-tired public transportation service providers, are also discussed.

Chapter 3 presents a market research approach to planning public transportation service to airports, including a case study on planning for the Logan Express bus service to Boston-Logan International Airport.

Chapter 4 presents examples of the most successful airport access systems from around the world. For each successful

system, four attributes are examined: (1) the characteristics of the line-haul trip to downtown, (2) characteristics of the integration with the regional system, (3) characteristics of the airport–rail connection, and (4) strategies for handling baggage.

Chapter 5 discusses the lessons learned from the successful airport access systems.

Chapter 6 describes new and emerging technologies to improve public transportation services at airports. These technologies include Advanced Traveler Information Systems (ATIS), technologies for ride sharing, and various bus and rail technologies.

Chapter 7 presents the institutional environment and factors affecting public transportation access to large U.S. airports. FAA and contractual barriers are discussed.

Chapter 8 presents chapter by chapter implications for further research on improving public transportation access to large U.S. airports.

Also included in the report is a glossary, which is divided into two sections. The first section lists the abbreviations and acronyms used in the report, and the second lists the airports mentioned.

DEFINING THE LARGE U.S. AIRPORTS

Alternative definitions of a “large” airport were considered, including those used by the Federal Aviation Administration (FAA) and other industry groups. Because this research is focused on ground access and public transportation services, it was proposed that airports be ranked and selected according to their numbers of originating passengers rather than enplaned passengers. Enplaned passengers are all outbound airline passengers, including those who are connecting between flights; originating passengers include only those airline passengers whose trips begin at the subject airport.

Table 1-1 presents the top 40 U.S. airports ranked in order of 1998 originating domestic passengers. These airports are considered large airports for the purposes of this research. As shown in the table, the number of annual originating passengers at these airports ranges from 18.3 million (at Los Angeles International Airport) to 3.3 million (at Luis Munoz Marin International Airport, San Juan, Puerto Rico).

Table 1-1 also shows the 1998 number of enplaned passengers at the selected airports—a measure used by the FAA and other aviation industry groups to rank airports. The number of annual enplaned passengers at the selected large airports

TABLE 1-1 Airport activity statistics for the top 40 U.S. airports

Airport	1998		Estimated 1998 average daily employees (c)
	Enplaned passengers (a)	Originating passengers (b)	
Los Angeles	30,826,859	18,313,990	40,000
O'Hare (Chicago)	35,841,551	16,127,120	40,000
Hartsfield Atlanta	36,756,666	14,171,870	n.a.
San Francisco	19,658,626	12,531,590	31,000
Dallas/Fort Worth	30,121,523	11,279,510	48,000
Orlando	13,792,207	11,165,810	n.a.
McCarran (Las Vegas)	15,132,220	11,114,050	7,500
Newark	16,329,803	11,010,360	n.a.
Boston-Logan	13,250,754	10,364,870	14,500
Phoenix Sky Harbor	15,984,620	10,323,330	23,655
LaGuardia (New York)	11,422,760	10,185,220	n.a.
Seattle-Tacoma	12,867,830	9,592,000	11,375
Denver	18,444,540	8,956,900	17,400
Detroit Metropolitan Wayne County	15,699,434	7,913,400	n.a.
Miami	16,979,313	7,419,890	n.a.
Philadelphia	12,076,179	7,093,500	n.a.
San Diego	7,453,186	6,980,960	2,600
Minneapolis-St. Paul	15,310,345	6,616,600	n.a.
Reagan Washington National	7,895,144	6,477,270	n.a.
Baltimore/Washington	7,504,114	6,466,320	n.a.
Honolulu	11,124,200	6,439,650	n.a.
Bush Intercontinental/Houston	15,492,252	6,356,870	14,406
Tampa	6,955,805	6,289,530	8,219
John F. Kennedy	15,554,643	6,203,040	41,000 (1987)
Lambert-St. Louis	14,334,844	5,442,800	19,000
Fort Lauderdale-Hollywood	6,244,493	5,386,440	n.a.
Portland	6,487,226	5,353,170	5,000
San Jose	5,202,502	4,861,650	3,500
Kansas City	5,586,637	4,798,840	n.a.
Salt Lake City	10,097,036	4,762,760	13,026
Washington Dulles	7,803,962	4,669,510	n.a.
Midway (Chicago)	5,418,830	4,488,750	n.a.
Cleveland Hopkins	6,136,885	4,216,330	n.a.
Metropolitan Oakland	4,612,614	4,183,300	10,500
New Orleans	4,476,612	4,141,710	n.a.
John Wayne (Orange County)	3,715,780	3,660,000	n.a.
Sacramento	3,593,647	3,521,200	2,300
Pittsburgh	10,269,712	3,471,360	n.a.
Indianapolis	3,651,527	3,431,760	n.a.
Luis Munoz Marin (San Juan)	n.a.	3,283,550	n.a.

n.a. = Not available.

(a) Airports Council International, *The World's Airports in 1998, "Airport Ranking by Total Passengers,"* 1999.

(b) U.S. Department of Transportation/Federal Aviation Administration, *Origin-Destination Survey of Airline Passenger Traffic, Domestic.*

(c) Information provided by airport operators, 1999.

ranges from 36.8 million (at Hartsfield Atlanta International Airport) to 3.6 million (at Sacramento International Airport). A list of large airports ranked by numbers of enplaned passengers would include the airports serving Charlotte (11.4 million passengers), Cincinnati (10.6 million passengers), and Memphis (5.1 million passengers). However, these airports are ranked lower in terms of originating passengers because con-

necting passengers account for more than 70 percent of the enplaned passengers at these airports.

The FAA classifies regions as large-, medium-, small-, and non-hub based on the percentage of the nation's enplaned passengers enplaning at the airports in the region. Because the classification is based on geographic areas, some of which include several airports (e.g., Los Angeles and Dallas), some

airports are classified as large-hub airports but are not included in the list of “large” airports addressed in this study. For example, Burbank-Glendale-Pasadena Airport and Dallas Love Field are classified as large-hub airports because of their geographic locations but are not included in this study’s list of “large” airports.

Employees working at an airport, including those working for the airport operator, the airlines, and other airport tenants (e.g., catering services, freight forwarders, and concessionaires), represent a significant market for public transportation. Data that indicated the average daily number of employees were available for 18 airports. Five of the airports reported 30,000 or more employees (Los Angeles, Chicago-O’Hare, San Francisco, Dallas/Fort Worth, and John F. Kennedy International Airports), and seven reported between 11,000 and 24,000 employees (Phoenix Sky Harbor, Boston-Logan, Seattle-Tacoma, Denver, Lambert-St. Louis, and Salt Lake City International Airports and Bush Intercontinental Airport/Houston). Each of these 12 airports serves as an airline hub, an airline maintenance base, or both. The remaining airports reported between 10,500 employees (Metropolitan Oakland) and 2,300 employees (Sacramento).

DEFINITIONS OF GROUND TRANSPORTATION SERVICES

Mode choice and other airport access data to large airports are assembled in Appendix A and summarized in Chapter 2. The following definitions of ground transportation services available at these airports were prepared to guide this effort and ensure the consistent use of terms throughout the project. The definitions of terms used in this report are as follows:

1. **Private vehicles:** vehicles used to transport airline passengers or visitors (e.g., family members, employees, friends, or clients), without payment of a fare by the passenger, which are privately owned and privately operated.
2. **Rental cars:** vehicles used to transport airline passengers or visitors, which are leased by the passenger or visitor from an agency doing business at or near the airport and rented for the duration of the passenger’s or visitor’s trip. Vehicles rented under a long-term lease (i.e., greater than 3 months) are considered private vehicles, not rental cars.
3. **Courtesy vehicles:** door-to-door, shared-ride transportation provided for customers of hotels, motels, rental car agencies, parking lots (both those privately operated and airport-operated), and other services. Typically, no fare is charged because the transportation service is considered part of (or incidental to) the primary service being provided. Service is provided using a variety of vehicles, including full-size buses, minibuses, vans, and station wagons.
4. **Airline crew vehicles:** shared-ride transportation between airports and hotels provided at no charge for airline crew members by the employer. Service is provided using a variety of vehicles, including full-size buses, minibuses, vans, and station wagons.
5. **Taxicabs:** privately operated door-to-door, on-demand, exclusive transportation (i.e., for a single party, typically up to five persons). Fares are typically calculated according to trip length and travel time using a taximeter and according to rates established by a city or county licensing agency (e.g., a taxicab commission or public services commission), but fares may be zone fares, flat fares (predetermined fares between certain points, such as the airport and downtown), or negotiated fares. Typically, the fare is for use of the entire vehicle, although some communities allow extra fares per passenger or piece of baggage.
6. **Town cars (on-demand limousines):** privately operated door-to-door, on-demand ground transportation services that typically charge premium fares calculated on a per-mile and per-hour basis, available at the curbsides of some airports. These exclusive transportation services are typically provided using luxury town cars or limousines.
7. **Prearranged limousines:** door-to-door services that provide exclusive transportation and require reservations. Fares may be flat, calculated on a per-hour basis, or negotiated, regardless of the number of persons transported, according to rates approved by local or state licensing agencies. Such agencies sometimes also specify the geographic area that can be served and the tariff (or maximum fee) that can be charged. Prearranged limousine services are typically provided using luxury vehicles and include private car services (“black cars”), luxury limousine services, and suburban taxicabs (i.e., prearranged taxicab service provided by an operator not licensed to provide on-demand service at the airport). These services typically require prior reservations but may also be dispatched by radio requests. Prearranged limousines are not permitted to respond to hails or on-demand requests for transportation.

Privately owned and privately operated luxury limousines are considered private vehicles, as are those operated or leased by a corporation. However, most surveys do not distinguish between privately owned and other types of limousines.
8. **Chartered buses and vans:** exclusive, door-to-door transportation services requiring reservations or prior arrangements. Fares are typically calculated on a per-hour basis regardless of the number of persons transported, according to tariffs approved by local or state

licensing agencies. Chartered bus and van services are provided using buses, minibuses, and vans (seating eight or more passengers) and include tour buses, cruise-ship buses, and other prearranged transportation for more than five passengers.

9. **Shared-ride, door-to-door vans:** shared-ride, door-to-door transportation services, which charge customers a predetermined flat fare per passenger or zone. Typically, transportation from the airport is on-demand, but transportation to the airport requires prior reservations. Vehicles may be licensed as shared-ride vans, airport transfer vans, or, in some communities, as taxicabs or prearranged/chartered vans. In most communities, the service is operated using radio-dispatched, eight-passenger vans, but station wagons, limousines, and sedans are also used.
10. **Scheduled buses:** scheduled service operating to established stops or terminals, typically on a scheduled basis, along a fixed route, which charges a predetermined flat fare per passenger or zone. In many communities, there are two classes of bus service:
 - *Express (including semi-express) transportation* between the airport and major destinations in the region, often provided by a private operator licensed by state or regional agencies but in some communities are provided by a public operator. Sometimes referred to as “airporters.”
 - *Multistop transportation* between the airport and the region, typically operated by a public agency (i.e., traditional bus service).
11. **Rail service:** Fixed-route rail service operating to established stops or terminals on a scheduled basis. Customers are charged a predetermined flat fare per passenger or zone. Types of trains used to provide this service include light rail, commuter rail, and rapid transit.

CANDIDATE DEFINITIONS OF PUBLIC TRANSPORTATION

The American Public Transportation Association (APTA) defines public transportation as “transportation by bus, rail, or other conveyance, either publicly or privately owned, which provides to the public general or special service on a regular and continuing basis.” This report addresses public transportation services at large airports in the United States and selected international airports.

At airports, a wide variety of ground transportation services is available to the traveling public. For the purposes of this research project, it is necessary to select those services to be included in the definition of “public transportation.”

Three definitions of “public transportation” to large airports were considered—Alternatives A, B, and C. Each alternative

definition includes specific airport ground transportation services described above. All alternatives exclude private vehicles, rental cars, airline crew vehicles, taxicabs, and town cars (on-demand limousines).

Alternative A

Alternative A includes those ground transportation services that are traditionally defined as public transportation for commuting purposes. Specifically, Alternative A includes express and multistop buses and rail service.

Alternative B

Alternative B includes those ground transportation services in Alternative A, with the addition of shared-ride, door-to-door vans. This definition of public transportation categorizes those services that are (1) available to the general public, and (2) intended to transport more than one passenger or small group of passengers traveling together. This alternative excludes courtesy vehicles and charter buses and vans, as these are generally not available to the general public. For example, to be transported on a hotel or motel courtesy vehicle, passengers must be guests of the hotel or motel.

Alternative C

Alternative C includes those ground transportation services in Alternative B, with the addition of courtesy vehicles, prearranged limousines, and chartered buses and vans.

PROPOSED DEFINITION OF PUBLIC TRANSPORTATION

For each of the alternative definitions, Table 1-2 presents public transportation market share data (by type of service) for 35 of the 40 large U.S. airports. (Mode choice and other airport access data were not available for Detroit Metropolitan [Wayne County] Airport, Honolulu International Airport, John Wayne Airport [Orange County, California], Pittsburgh International Airport, and Luis Munoz Marin International Airport [San Juan, Puerto Rico]; these airports are not considered in the analyses presented in Chapter 2.) As shown in Table 1-3, which presents airport rankings by public transportation market share as categorized according to the three alternative definitions, Boston-Logan Airport ranks in the top three airports under each definition, and San Francisco International Airport and Washington, D.C.’s Reagan National Airport rank in the top three airports under two of the three

TABLE 1-2 Public transportation market share data by modal service at large U.S. airports

Airport	Rail	Buses		Alternative A [A+B+C]	Shared-ride vans [D]	Alternative B [A+B+C+D]	Charter buses & pre-arranged limousines [E]	Hotel/motel courtesy vehicles [F]	Alternative C [A+B+C+D+E+F]
	[A]	Multi-stop [B]	Express [C]						
Hartsfield Atlanta	7.9%	--	--	7.9%	--	7.9%	--	7.2%	15.1%
Baltimore/Washington	0.6	--	6.7%	7.3	--	7.3	--	3.7	11.0
Boston-Logan	5.7	--	11.9	17.6	1.0%	18.6	9.0%	2.2	29.8
Midway (Chicago)	7.7	--	3.5	11.2	--	11.2	--	--	11.2
O'Hare (Chicago)	3.9	0.6%	4.7	9.2	--	9.2	11.7	3.2	24.1
Cleveland Hopkins	2.8	--	3.0	5.8	--	5.8	--	3.0	8.8
Dallas/Fort worth	--	--	--	0.0	6.3	6.3	--	7.5	13.8
Denver	--	3.5	8.1	11.6	2.6	14.2	1.4	3.1	18.7
Fort Lauderdale-Hollywood	0.2	--	--	0.2	--	0.2	3.4	1.4	5.0
Bush Intercontinental/Houston	--	--	--	0.0	--	0.0	--	3.9	3.9
Indianapolis	--	--	8.7	8.7	--	8.7	6.2	4.4	19.3
Kansas City	--	--	2.8	2.8	1.7	4.5	--	5.3	9.8
McCarran (Las Vegas)	--	0.1	--	0.1	12.5	12.6	4.0	7.2	23.8
Los Angeles	0.5	--	7.4	7.9	5.2	13.1	8.9	5.0	27.0
Miami	1.2	--	--	1.2	3.4	4.6	9.5	3.7	17.8
Minneapolis-St. Paul	--	1.0	2.0	3.0	--	3.0	--	--	3.0
Newark	--	--	7.0	7.0	--	7.0	21.0	--	28.0
New Orleans	--	--	16.0	16.0	--	16.0	--	5.0	21.0
LaGuardia (New York)	--	--	5.0	5.0	--	5.0	22.0	--	27.0
John F. Kennedy (New York)	--	--	8.0	8.0	--	8.0	20.0	--	28.0
Metropolitan Oakland	4.1	1.2	1.3	6.6	1.5	8.1	1.1	1.5	10.7
Orlando	--	--	--	0.0	11.5	11.5	5.1	3.6	20.2
Philadelphia	2.0	1.0	--	3.0	4.0	7.0	3.0	3.0	13.0
Phoenix Sky Harbor	--	1.0	--	1.0	8.0	9.0	--	6.0	15.0
Portland	--	1.0	3.0	4.0	--	4.0	1.0	7.0	12.0
Sacramento	--	--	--	0.0	5.0	5.0	--	1.0	6.0
Lambert-St. Louis	3.3	--	1.7	5.0	1.0	6.0	--	6.1	12.1
Salt Lake City	--	0.6	--	0.6	--	0.6	--	8.6	9.2
San Diego	--	--	--	0.0	9.0	9.0	--	10.0	19.0
San Francisco	--	4.0	5.0	9.0	12.0	21.0	4.0	7.0	32.0
San Jose	--	0.7	1.4	2.1	1.6	3.7	0.1	2.8	6.6
Seattle-Tacoma	--	1.1	5.9	7.0	4.8	11.8	1.0	1.9	14.7
Tampa	--	--	0.3	0.3	7.0	7.3	--	6.0	13.3
Reagan Washington National	13.8	--	2.1	15.9	1.6	17.5	--	4.7	22.2
Washington Dulles	1.1	--	3.9	5.0	1.3	6.3	--	4.1	10.4

SOURCE: Leigh Fisher Associates, based on information provided by airport management, December 1999.

TABLE 1-3 Airport rankings under three alternative definitions of public transportation

Rank	Alternative A	Alternative B	Alternative C
1	Boston-Logan	San Francisco	San Francisco
2	New Orleans	Boston-Logan	Boston-Logan
3	Reagan Washington National	Reagan Washington National	John F. Kennedy (New York)
4	Denver	New Orleans	Newark
5	Midway (Chicago)	Denver	LaGuardia (New York)
6	O'Hare (Chicago)	Los Angeles	Los Angeles
7	San Francisco	McCarran (Las Vegas)	O'Hare (Chicago)
8	Indianapolis	Seattle-Tacoma	McCarran (Las Vegas)
9	John F. Kennedy (New York)	Orlando	Reagan Washington National
10	Hartsfield Atlanta	Midway (Chicago)	New Orleans
11	Los Angeles	O'Hare (Chicago)	Orlando
12	Baltimore/Washington	Phoenix Sky Harbor	Indianapolis
13	Newark	San Diego	San Diego
14	Seattle-Tacoma	Indianapolis	Denver
15	Metropolitan Oakland	Metropolitan Oakland	Miami
16	Cleveland Hopkins	John F. Kennedy (New York)	Hartsfield Atlanta
17	LaGuardia (New York)	Hartsfield Atlanta	Phoenix Sky Harbor
18	Lambert-St. Louis	Baltimore/Washington	Seattle-Tacoma
19	Washington Dulles	Tampa	Dallas/Fort Worth
20	Portland	Newark	Tampa
21	Minneapolis-St. Paul	Philadelphia	Philadelphia
22	Philadelphia	Dallas/Fort Worth	Lambert-St. Louis
23	Kansas City	Washington Dulles	Portland
24	San Jose	Lambert-St. Louis	Midway (Chicago)
25	Miami	Cleveland Hopkins	Baltimore/Washington
26	Phoenix Sky Harbor	LaGuardia (New York)	Metropolitan Oakland
27	Salt Lake City	Sacramento	Washington Dulles
28	Tampa	Miami	Kansas City
29	Fort Lauderdale-Hollywood	Kansas City	Salt Lake City
30	McCarran (Las Vegas)	Portland	Cleveland Hopkins
31	Bush Intercontinental/Houston	San Jose	San Jose
32	Dallas/Fort Worth	Minneapolis-St. Paul	Sacramento
33	Orlando	Salt Lake City	Fort Lauderdale-Hollywood
34	Sacramento	Fort Lauderdale-Hollywood	Bush Intercontinental/Houston
35	San Diego	Bush Intercontinental/Houston	Minneapolis-St. Paul

Alternative A = Express and multi-stop buses and rail service.

Alternative B = All of the above, plus shared-ride, door-to-door vans.

Alternative C = All of the above, plus courtesy vehicles, pre-arranged limousines, and chartered buses and vans.

SOURCE: Leigh Fisher Associates, based on information provided by airport management, December 1999.

definitions. Generally, these three airports are considered well-served by public transportation.

While each of the definitions has merit, Alternative B includes ground transportation services that best describe the market available to people who wish to travel by public transportation between the airport and destinations in the region served by the airport. Alternative B includes shared-

ride, door-to-door vans, which are the fastest growing category of publicly available transportation at many airports. Therefore, Alternative B is the definition of public transportation that is used in the remainder of this report. Figure 1-1 shows market share data for each of the 33 airports, ranked according to the Alternative B public transportation definition.

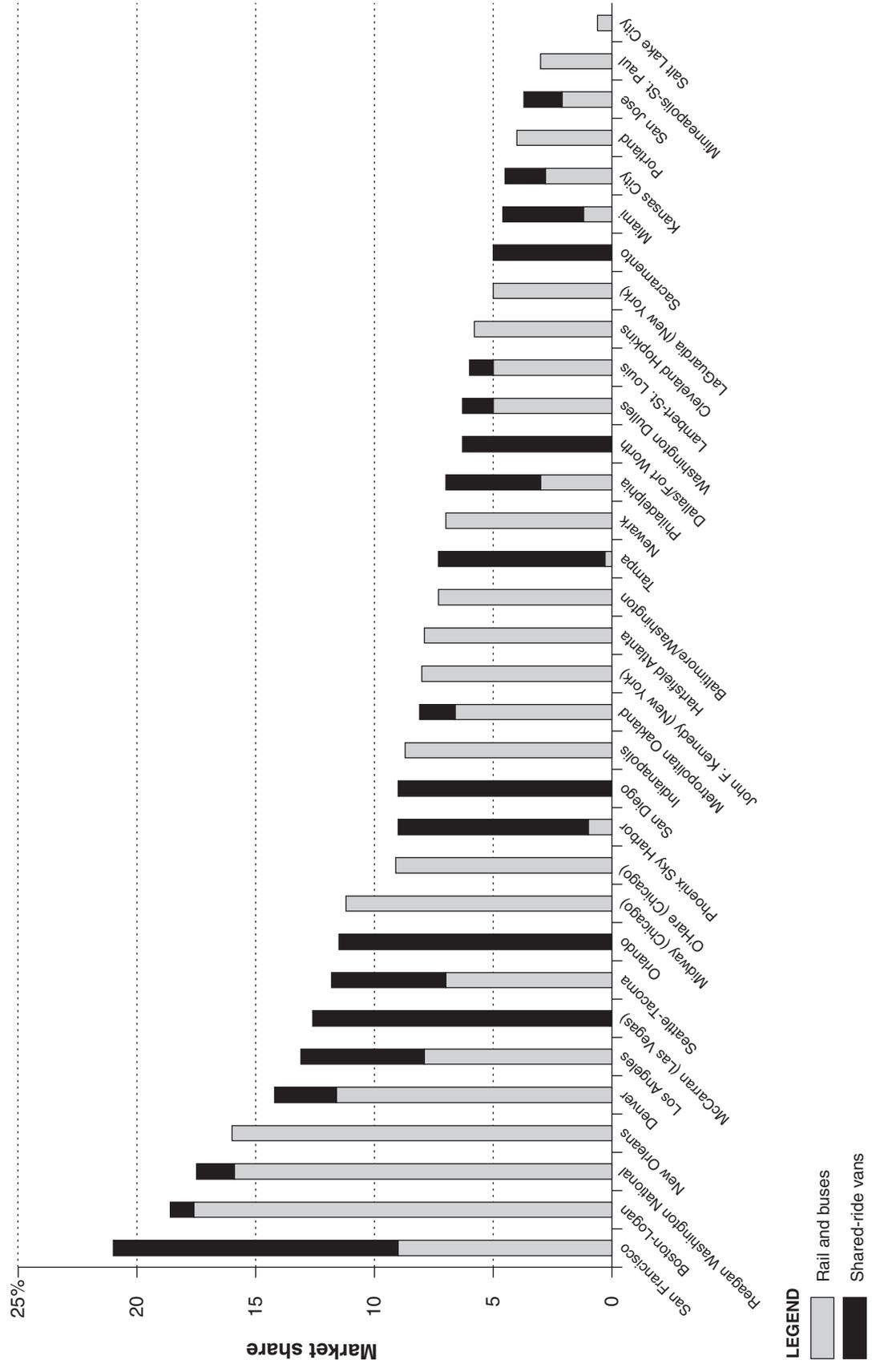


Figure 1-1. Public transportation market share at large U.S. airports.

SOURCE: Leigh Fisher Associates, based on information provided by airport management.

CHAPTER 2

CURRENT STATUS OF PUBLIC TRANSPORTATION SERVICES TO LARGE AIRPORTS

This chapter describes the travel mode choice patterns and other data for passengers and employees at selected large U.S. and international airports. Key factors affecting passenger and employee use of public transportation for airport access are also presented.

U.S. AIRPORT DATA REVIEWED

Passenger and employee market share data were assembled using reports, studies, surveys, and other material. The available data were reviewed, clarified to eliminate obvious errors, and then summarized using consistent terms and definitions. Airport managers were asked to review, correct, and update the summarized data. The final data, which incorporated review comments from airport managers, are summarized in this section and presented in full in Appendix A. Appendix B contains brief descriptions of the ground transportation services provided at the selected large airports. The following information was assembled.

- **Airline passenger characteristics.** The proportion of resident/nonresident and business/nonbusiness passengers influences the potential market for transit services. Resident passengers are likely to be more familiar with the public transportation system serving the airport than nonresidents. Typically, nonbusiness passengers are less time-sensitive and more price-sensitive than business passengers and are more likely to use public transportation. Thus, resident, nonbusiness passengers often represent a primary target market for public transportation. However, nonbusiness passengers typically travel with more baggage than business travelers and are not as easily accommodated on public transportation. There are also other exceptions. For example, because business passengers value travel-time reliability, they are apt to use transit (rail or high-occupancy-vehicle [HOV] lanes) if airport access routes are subject to frequent and lengthy delays.
- **Passenger and employee mode choice patterns.** Most of the recent airline passenger and employee travel mode choice data were obtained from surveys conducted by airport operators; some data are from surveys conducted by metropolitan planning organizations (MPOs) (e.g., data from the San Francisco Bay Area and Washington, D.C.)

or local transit operators (e.g., data from Atlanta and Chicago). Often the level of detail (e.g., separating courtesy vans from scheduled vans) reflects the original purpose of the survey sponsor.

- **Relationship to central business district.** An airport's proximity to the central business district (CBD) (or other major activity center) and the proportion of passengers beginning or ending their trips in the CBD are significant factors in the use of public transportation.
- **Travel time and costs.** Differential travel times and travel costs between the airport and the CBD influence airport employee and passenger use of public transportation modes as well as private vehicles. Other influences are the cost of daily parking in convenient facilities near the terminal as well as in remote, reduced-rate facilities.
- **Location of transit stops and stations.** Walking distances between the transit boarding/alighting areas and the number of level changes encountered influence transit mode choices. Data indicate the current availability of moving sidewalks or automated people mover systems. The level of convenience transit riders encounter at the airport and at the opposite end of their trip affect the decision to use transit.
- **Key factors affecting airline passenger and airport employee use of transit service.** Airport staff were asked to indicate the primary factors affecting passenger and employee use of transit. Their responses are summarized at the end of this chapter.

AIRLINE PASSENGER TRIP PURPOSE

Airline passenger trip purpose data were reviewed for 25 airports. The 25 airports are grouped in Table 2-1 according to the trip purpose of originating passengers (business versus leisure). The trip purpose will usually affect a passenger's decision whether to use public transportation to the airport because of several factors, such as frequency of trips, duration of trips, and sensitivity of passengers to time. For example, airline passengers traveling on business may have more information available on access options at specific airports, because they tend to make more trips by air than airline passengers traveling on leisure. Certain business travel arrangements may also require the use of particular airport access modes.

TABLE 2-1 Percent of airline passengers on business-related trips

More than 55%	45% to 55%	35% to 44%	Less than 35%
Hartsfield Atlanta International Airport (66%)	Boston-Logan International Airport (54%)	San Francisco International Airport (41%)	Los Angeles International Airport (32%)
Reagan Washington National Airport (64%)	Baltimore/Washington International Airport (54%)	San Diego International Airport (40%)	McCarran International Airport (Las Vegas) (30%)
Dallas/Fort Worth International Airport (57%)	Seattle-Tacoma International Airport (54%)	Tampa International Airport (37%)	Orlando International Airport (23%)
Kansas City International Airport (57%)	Washington Dulles International Airport (52%)	Midway Airport (Chicago) (37%)	Fort Lauderdale-Hollywood International Airport (23%)
New Orleans International Airport (56%)	O'Hare International Airport (Chicago) (50%)	Phoenix Sky Harbor International Airport (36%)	
	Metropolitan Oakland International Airport (50%)	Portland International Airport (36%)	
	San Jose International Airport (48%)	Salt Lake City International Airport (36%)	
	Denver International Airport (47%)		
	Sacramento International Airport (46%)		

SOURCE: Leigh Fisher Associates, based on information provided by airport management.

Five airports appear to be dominated by business travelers. The two airports with the largest proportion of business passengers (Hartsfield Atlanta and Reagan National) also attract significant rail ridership (as discussed in subsequent paragraphs), in part because of the business travelers. At nine airports, between 45 percent and 55 percent of all airline passengers are making business-related trips. It is anticipated that the category of airports dominated by business travelers would include most U.S. airports if trip purpose data were available. At seven airports, 35 percent to 44 percent of all airline passengers are on business-related trips. Many of these airports (e.g., San Francisco, San Diego, Tampa, and Salt Lake City International Airports) serve a combination of business and resort/leisure markets. Airports with fewer than 35 percent business travelers primarily serve leisure markets (e.g., Las Vegas, Fort Lauderdale, and Orlando).

AIRLINE PASSENGER RESIDENCE DATA

Data describing airline passenger place of residence were available from 23 airports. The available data also suggest four groups of airports, as shown in Table 2-2. Local residents represented in Table 2-2 are airline passengers who are considered part of the airport's local market area and live close enough to access the airport using ground transportation. Airline passengers who are not local residents are visitors who do not live within the market area of the airport they are using. Resident airline passengers are more likely to have (1) a private vehicle, (2) more information on airport access, and (3) more familiarity with regional traffic patterns and transportation options.

More than 50 percent of the airline passengers at seven airports surveyed are local residents. These airports include those that serve as large airline connecting hubs (Dallas/Fort Worth, Chicago-O'Hare, and Hartsfield Atlanta), plus airports located on the East and West Coasts (Boston-Logan, Metropolitan Oakland, and Seattle-Tacoma). The proximity to leisure markets or vacation destinations influences the passenger profile at airports serving fewer than 50 percent residents, (e.g., San Francisco, Los Angeles, Ft. Lauderdale-Hollywood, Tampa, Las Vegas McCarran, and Orlando). The data for Washington, D.C.'s Dulles International and Reagan National Airports may be misleading, as "resident" may have been defined in the survey process to include only Washington, D.C., residents.

ORIGINATING AIRLINE PASSENGER MARKET SHARE DATA BY MODAL SERVICE AT LARGE U.S. AIRPORTS

The available mode choice (i.e., market share) data for originating airline passengers at large U.S. airports are discussed below. (Unless otherwise noted in the following sections, "passengers" refers to originating airline passengers.) These data are presented to compare (1) airports with direct rail connections, (2) airports with shuttle bus service to rail stations, and (3) airports without rail service. For each group of airports, data are presented for public transportation modes (i.e., rail, multistop buses, express buses, and shared-ride vans) and for private/non-HOV modes (i.e., private vehicles, rental cars, hotel or motel courtesy vehicles, taxicabs or town cars, pre-arranged limousines, and charter buses). Data presented in

TABLE 2-2 Percent of airline passengers who are local residents

More than 55%	50% to 55%	40% to 49%	Less than 40%
Sacramento International Airport (69%)	Dallas/Fort Worth International Airport (54%)	San Jose International Airport (49%)	Phoenix Sky Harbor International Airport (38%)
Boston-Logan International Airport (59%)	O'Hare International Airport (Chicago) (54%)	Baltimore/Washington International Airport (47%)	Tampa International Airport (38%)
Seattle-Tacoma International Airport (57%)	Metropolitan Oakland International Airport (52%)	Salt Lake City International Airport (45%)	Washington Dulles International Airport (33%)
	Hartsfield Atlanta International Airport (50%)	San Francisco International Airport (43%)	New Orleans International Airport (28%)
		Los Angeles International Airport (42%)	Reagan Washington National Airport (29%)
		Fort Lauderdale-Hollywood International Airport (41%)	Orlando International Airport (27%)
		Denver International Airport (41%)	McCarran International Airport (Las Vegas) (17%)
		Portland International Airport (40%)	
		San Diego International Airport (40%)	

SOURCE: Leigh Fisher Associates, based on information provided by airport management.

this report (including Appendices A and B) are current as of March 1999, except as noted. Schedules, fares, and parking rates are subject to frequent change.

Airports with Direct Rail Connections

Figure 2-1 presents the mode share data for the eight U.S. airports with direct rail connections at the terminal. As shown, the airport with largest share of rail ridership is Reagan National, where 14 percent of all passengers use rail. At both Hartsfield Atlanta and Chicago Midway Airport, about 8 percent of all passengers use rail; 4 percent use rail at Chicago-O'Hare. Rail service is used by fewer than 3 percent of all passengers at the other four airports that have direct rail connections (Baltimore-Washington, Cleveland Hopkins, Philadelphia, and Lambert-St. Louis).

Among these eight airports, only Chicago-O'Hare and Philadelphia International have multistop bus service, which is used by about 0.6 percent and 1 percent of airline passengers, respectively. Express bus service is available at six of the eight airports (Baltimore-Washington, O'Hare, Midway, Cleveland Hopkins, Lambert-St. Louis, and Reagan National). The market share for bus plus rail services is about 16 percent at Reagan National, 11 percent at Chicago's Midway, and less than 8 percent at the other six airports. At only two of the eight airports is the total market share for all public transportation modes higher than 9 percent—Reagan National (18 percent) and Midway (11 percent).

As shown in Figure 2-2, despite the availability of rail service, 80 percent or more of all passengers at these eight air-

ports use private/non-HOV modes. This represents a higher use of transit than occurs at most of the airports with shuttle bus service to rail stations or the airports without rail service.

Airports with Shuttle Bus Service to Rail Stations

Figure 2-3 presents market share data for 11 large airports that provide shuttle bus service to rail stations on or near the airport. These airports include those serving Boston, Fort Lauderdale, Los Angeles, Miami, Newark, New York (John F. Kennedy and New York LaGuardia), Oakland, San Francisco, San Jose, and Washington, D.C. (Dulles).

The airports with the largest proportion of passengers using the shuttle bus connections to rail access are Boston-Logan (5.7 percent) and Metropolitan Oakland (4.1 percent). At the other nine airports, 1 percent or fewer passengers used rail service. While multistop bus service is available at most of these 11 airports, only three airports reported that more than 0.5 percent of passengers use these services—San Francisco (4 percent), Metropolitan Oakland (1.2 percent), and San Jose International Airports (data from all three airports were gathered from the Metropolitan Transportation Commission). Express bus service was reported to be used by more than 5 percent of airline passengers at Boston-Logan (11.9 percent), Los Angeles (7.4 percent), Newark (7.0 percent), LaGuardia (5.0 percent), JFK (8.0 percent), and San Francisco (5.0 percent) Airports.

Three of these airports have total public transportation market shares that are higher than that at most airports with direct

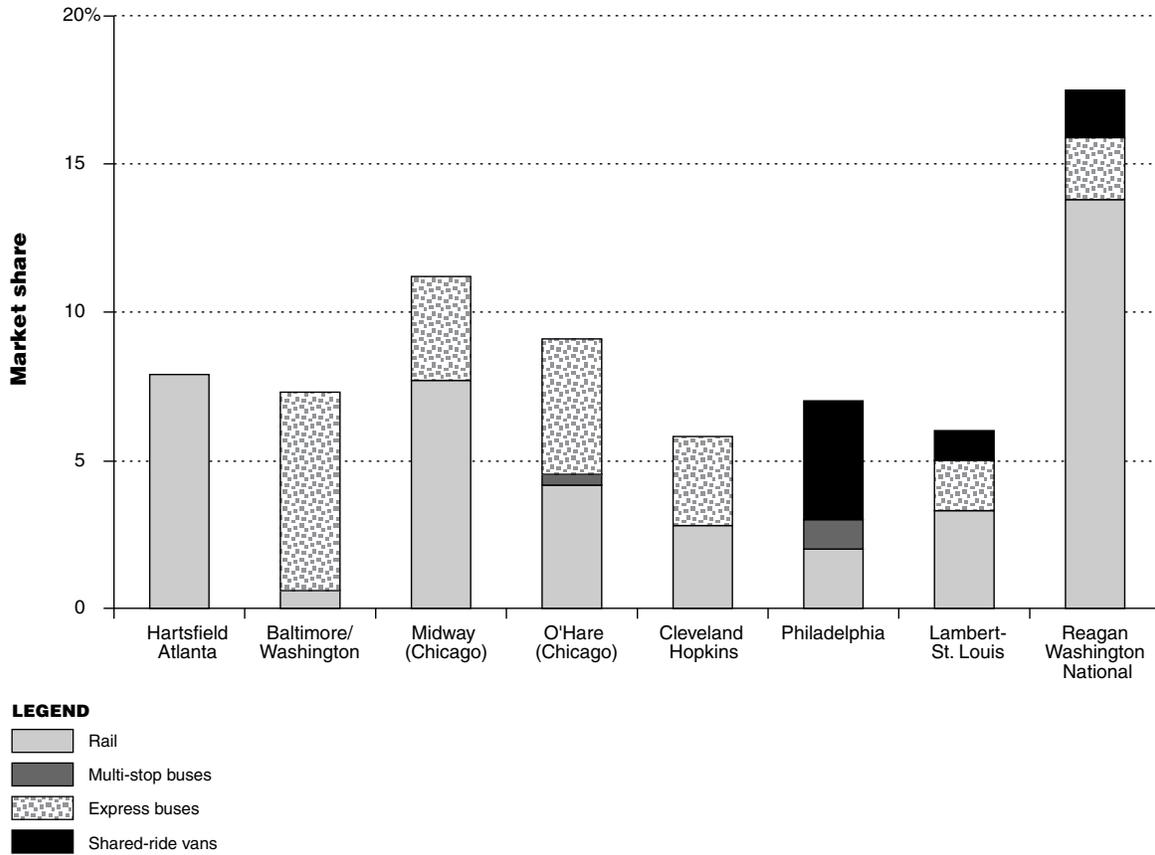


Figure 2-1. Public transportation market share patterns at large U.S. airports with direct rail connections. SOURCE: Leigh Fisher Associates, based on information received from airport management.

rail service. The total public transportation market shares at Boston-Logan and San Francisco Airports are higher than 20 percent (i.e., more than the share at any of the airports with direct rail service) and higher than 13 percent at Los Angeles Airport (i.e., more than at any airport other than Reagan National). About 12 percent of the passengers at the San Francisco airport and 7 percent at the Los Angeles airport use shared-ride vans. At the other eight airports with shuttle bus service to rail stations, fewer than 8 percent of all passengers use public transportation. Although 12 percent of all San Francisco Airport passengers use shared-ride vans, this mode is used by only about 2 percent of the passengers at nearby Oakland and San Jose Airports, despite the similar and overlapping market characteristics of the three airports.

As shown in Figure 2-4, private/non-HOV modes are used by more than 88 percent of passengers at 8 of the 11 airports with shuttle bus connections to rail (i.e., all except Boston-Logan, San Francisco, and Los Angeles Airports). Taxicabs and on-demand town car services are used by 29 percent of passengers at LaGuardia, 23 percent of passengers at Ft. Lauderdale-Hollywood International Airport, 22 percent of passengers at JFK, and 21 percent of passengers at Boston-Logan. In addition, prearranged limousine services are used

by over 20 percent of passengers at each of the three New York area airports—LaGuardia (22 percent), Newark (21 percent), and JFK (20 percent). Therefore, taxicabs and limousines are used by more than 51 percent of passengers at LaGuardia and by 42 percent of passengers at JFK.

Airports Without Rail Service

Figure 2-5 depicts the use of public transportation at 16 large airports that do not have rail service. The public transportation market shares at five of these airports—New Orleans (16 percent), Denver (14 percent), Las Vegas McCarran (12.6 percent), Seattle-Tacoma (12 percent), and Orlando (11.5 percent) International Airports—are higher than those observed at the airports that have direct rail service (excluding Reagan National) and three of the airports with shuttle bus service to rail stations (Boston-Logan, Los Angeles, and San Francisco).

All these airports are served by multistop or express bus services, or both. Multistop buses were used by about 3.5 percent of the passengers at Denver International Airport but by fewer than 1 percent of passengers at the other airports examined.

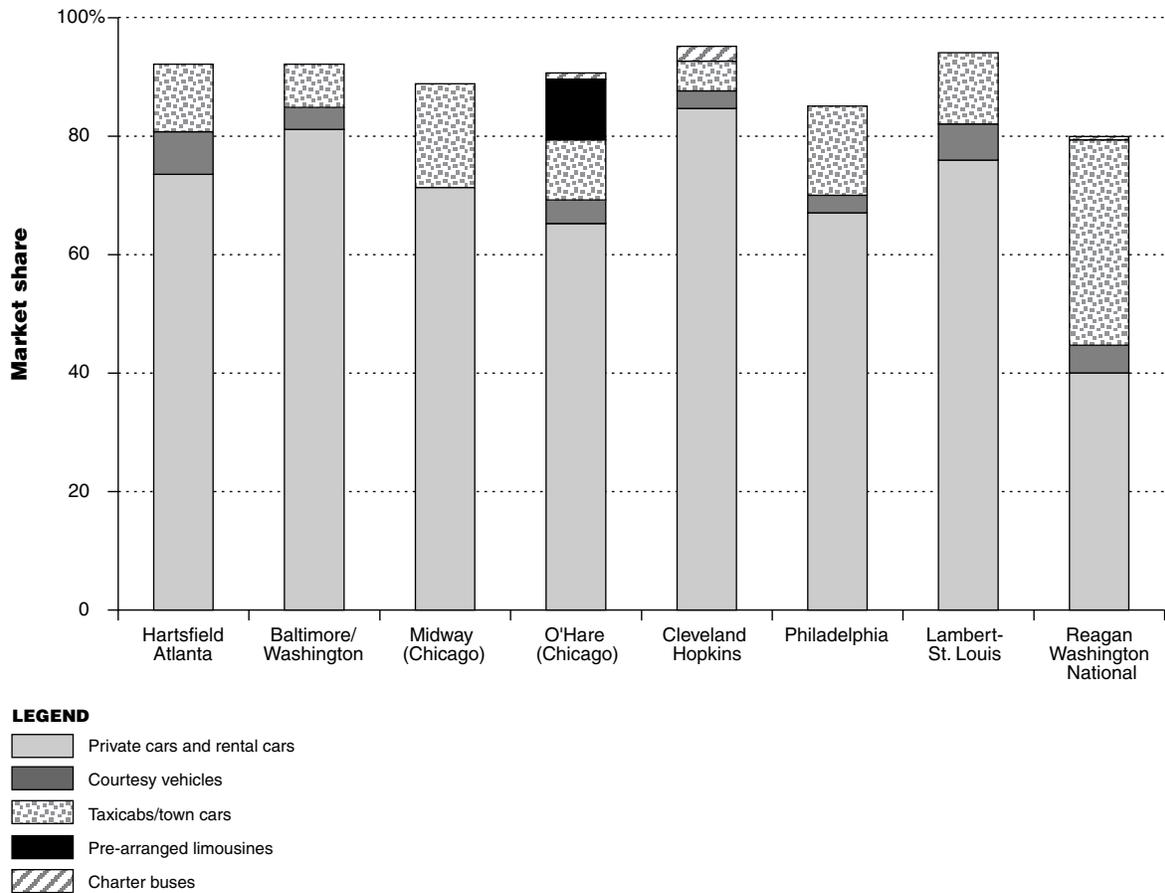


Figure 2-2. Private/non-HOV market share patterns at large U.S. airports with direct rail connections. SOURCE: Leigh Fisher Associates, based on information provided by airport management.

Significant use of express buses was reported at the international airports serving New Orleans (16 percent), Indianapolis (8.7 percent), Denver (8.1 percent), and Seattle and Tacoma (5.9 percent). Shared-ride van use at the following international airports exceeded 5 percent—Las Vegas McCarran (13 percent), Orlando (almost 12 percent), San Diego (9 percent), Phoenix Sky Harbor (8 percent), Tampa (7 percent), and Dallas/Fort Worth (6 percent). Market share data were not available for several airports with publicly operated buses (e.g., Pittsburgh and Honolulu).

As shown in Figure 2-6, more than 85 percent of the passengers at 13 of the 16 airports without rail service (i.e., all those except Denver, Las Vegas McCarran, and New Orleans) use private/non-HOV modes. Las Vegas McCarran has the largest taxicab market share in the United States (42 percent).

AIRPORT EMPLOYEE MARKET SHARE DATA BY MODAL SERVICE AT LARGE U.S. AIRPORTS

Few airport operators gather or maintain current data on employee transportation mode choice because airlines and

other airport tenants employ most of the people working at an airport. Employment statistics are complicated by such factors as based and non-based flight crews, the number of part-time and contract employees working for tenants, and other factors. Gathering accurate employment data (by time of day) is challenging. Gathering accurate market share data for such an employment base is more challenging.

Table 2-3 presents the reported mode choice data for the seven airports for which data were available.

As shown, private vehicles are the dominant access mode at all seven airports. It is anticipated that patterns observed at the airports in Table 2-3 would be replicated if data were available from additional airports.

Factors contributing to the employee mode choice patterns at Boston-Logan are the excellent regional coverage offered by the Massachusetts Bay Transit Authority service and the availability of the Logan Express bus service. Employee use of buses at the Denver airport reflects the popularity of the park-and-ride lot opened by the city and county of Denver at the site of the old airport (Denver Stapleton) when aviation operations were transferred to the new airport. The Regional Transportation District operates express bus service,

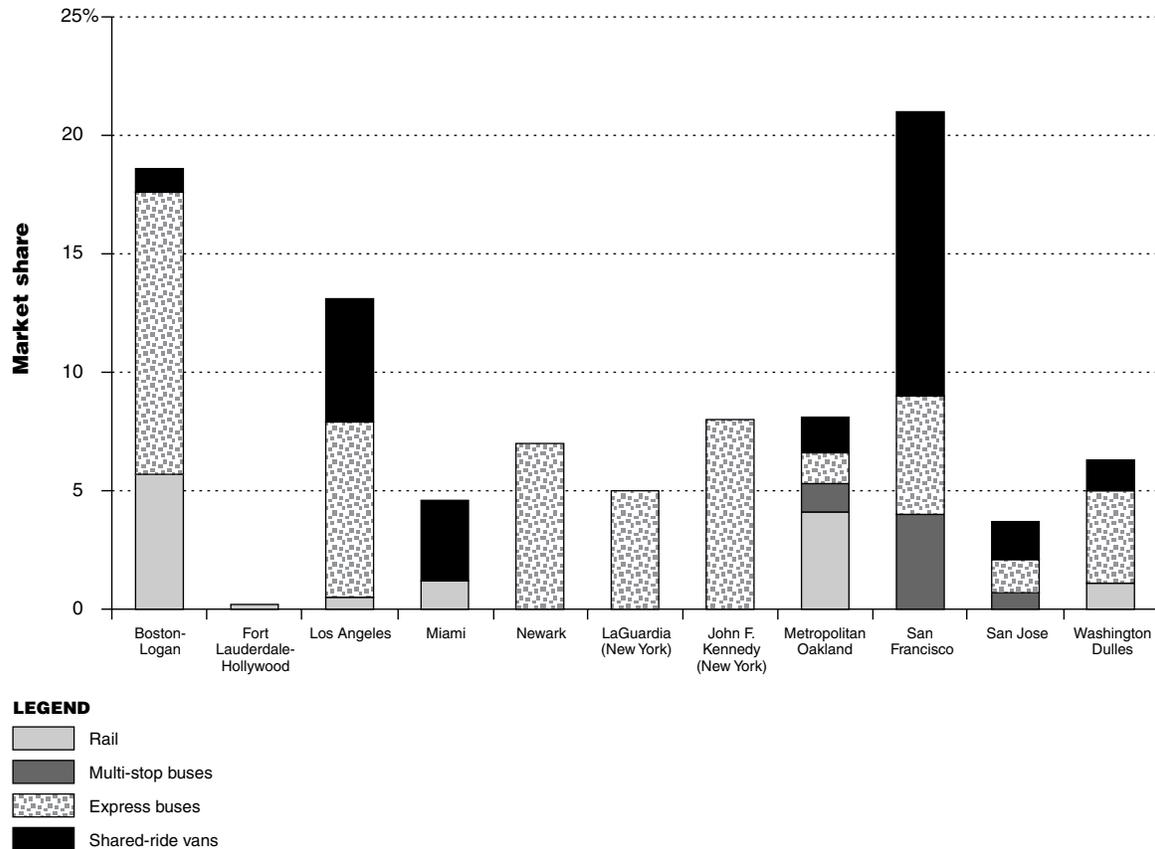


Figure 2-3. Public transportation market share patterns at large U.S. airports with shuttle bus service to rail stations.

SOURCE: Leigh Fisher Associates, based on information provided by airport management.

known as Skyride, between the new airport and the parking lot at the old airport. As evidenced by the mode choice data, this bus service attracts many employees who live near the old airport.

Factors affecting airport, airline, and tenant employee use of private vehicles are (1) the availability of parking provided to employees at little or no cost (as required by many labor agreements), (2) the round-the-clock nature of airport operations and the many employees working late-night hours, and (3) the lack of transit service between airports and neighborhoods where employees live.

MARKET TRENDS AND FACTORS AT U.S. AIRPORTS WITH DIRECT RAIL CONNECTIONS

The trends and factors affecting the use of rail for airport access in the United States are discussed below.

Market patterns for the nine U.S. airports where rail services are provided at or adjacent to the airport are examined in this section of the report. At some airports, such as Reagan National and Boston-Logan, some portion of the transit market used bus service. The air passenger market share is exam-

ined for airports where rail services are not provided directly to the airport. The airports with rail service are discussed below, in descending order of rail market share.

Reagan National Airport

Reagan National has the largest air passenger market share for rail of any airport in the United States. The rail service is provided by the Washington Metropolitan Area Transit Authority (WMATA).

Construction of the Metrorail station at the airport in the 1970s led to one of the largest increases in public transportation share ever recorded, from 2.5 percent (bus) before the new service to 16 percent (rail and bus) after the opening of the new station (see Figure 2-7). In the 1990s, the Metropolitan Washington Airports Authority began a major reconstruction program, which moved the main terminal adjacent to the Metrorail station. During this period, construction problems caused a significant degradation in service for those wishing to access the Metrorail. Rail market share decreased to about 11 percent but rebounded to 14 percent after the opening of the new terminals. The ongoing market

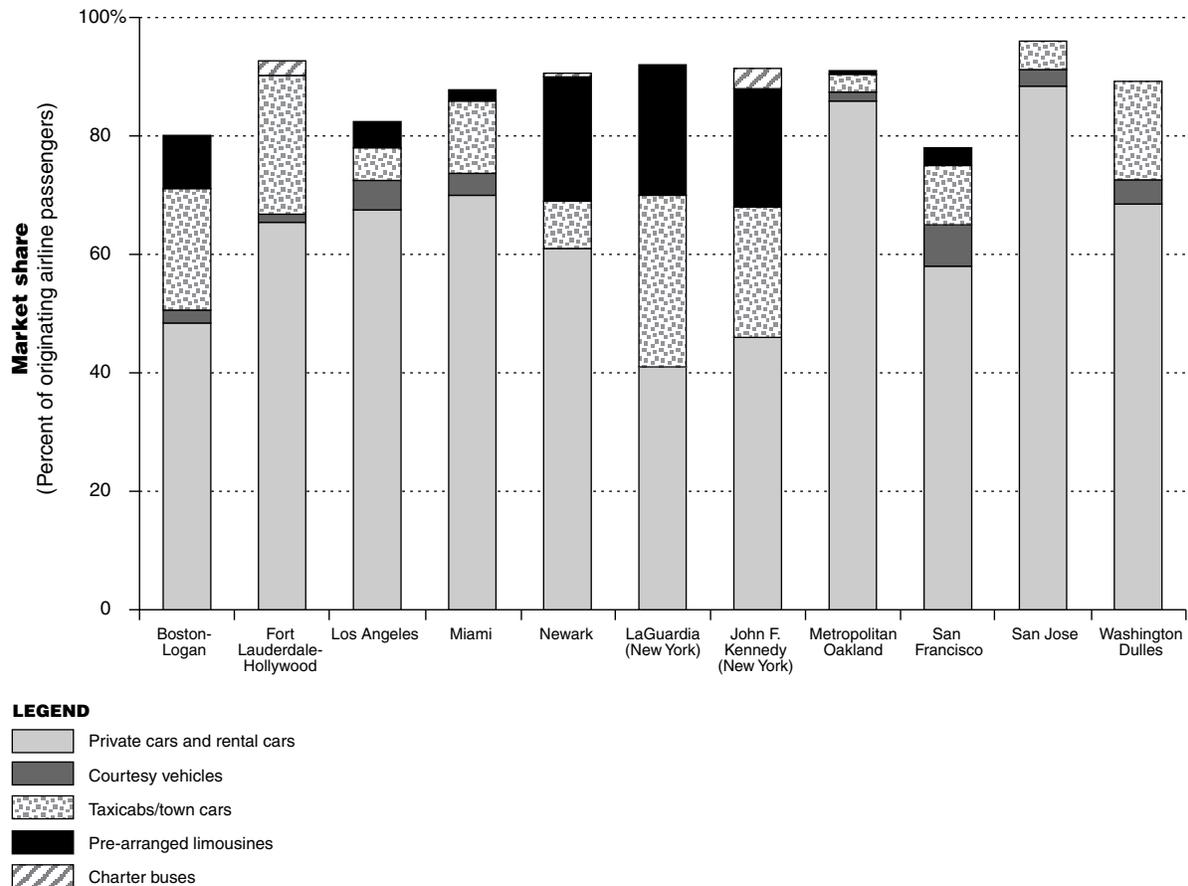


Figure 2-4. Private/non-HOV market share patterns at large U.S. airports with shuttle bus service to rail stations.

SOURCE: Leigh Fisher Associates, based on information provided by airport management.

research program of the Airports Authority reports a peak market share of 17 percent in 1995.

With the 1997 opening of the new integrated air-rail terminal at Reagan National, the airport has one of the shortest walking distances of any air-rail facility. Served by two rapid transit lines from one station, the Metrorail service offers excellent downtown distribution. The market for services from Reagan National is focused on the Washington, D.C., downtown and the close-in suburbs, most of which are directly served by the Metrorail network. With rapid transit fares generally under \$2 and 5-min headways, the airport service is well integrated with the regional transit strategy. During peak periods, the service is faster than taxis and buses to many downtown locations; during off-peak periods, taxis retain a small time advantage.

Other market factors contributing to the success of public transit access to Reagan National include

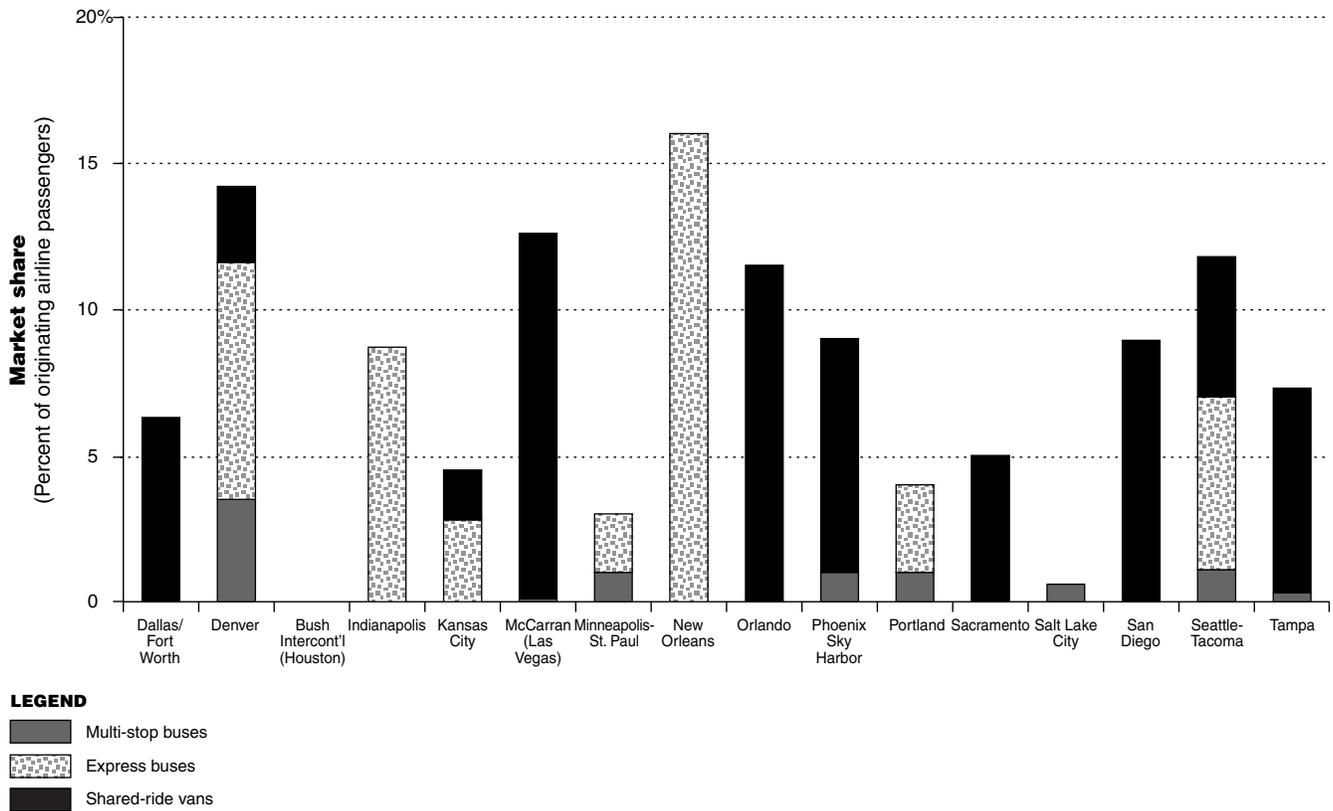
- A large number of shuttle bus passengers with little or no checked baggage;
- A large number of frequent flyers who are familiar with the Metrorail system;

- A cap on the number of flights/slots, which reduces the airport's catchment area (a higher proportion of the region is served by Dulles or Baltimore-Washington). As a result, a higher proportion of passengers using Reagan National live in or begin their trips in areas well served by the Metrorail; and
- A lack of public parking at the airport until 1995–1996.

Chicago Midway Airport

About 8 percent of air travelers choose the rail system at Chicago's Midway Airport. The rail service is provided by the Chicago Transit Authority (CTA), with the airport as the terminal of the service's Orange Line. Similar to many higher market share services, transit at Midway serves specific market segments well. Specifically, about 21 percent of air travelers from the Loop chose the Orange Line service (1).

Most of the users of Midway are residents, connecting to or from their homes (62 percent). Arriving air passengers chose the Orange Line with a higher propensity than departing passengers, at 8.7 percent versus 7.6 percent. The rail ser-



NOTE: Data were not available for Bush Intercontinental Airport/Houston.

Figure 2-5. Public transportation market share patterns at large U.S. airports without rail service.

SOURCE: Leigh Fisher Associates, based on information provided by airport management.

vice captured 21 percent of the air passengers to the Loop and 21 percent of air travelers to the Upper North Side.

Based on the results of CTA market research efforts, rail users select the Orange Line because it is “cheap” (38 percent), “fast” (36 percent), and “close by” (19 percent).

At the present time, a 1,000-foot-long bridge connects the air terminal and the rapid transit station. However, a new air terminal is being constructed closer to the CTA bus and rail station.

Hartsfield Atlanta International Airport

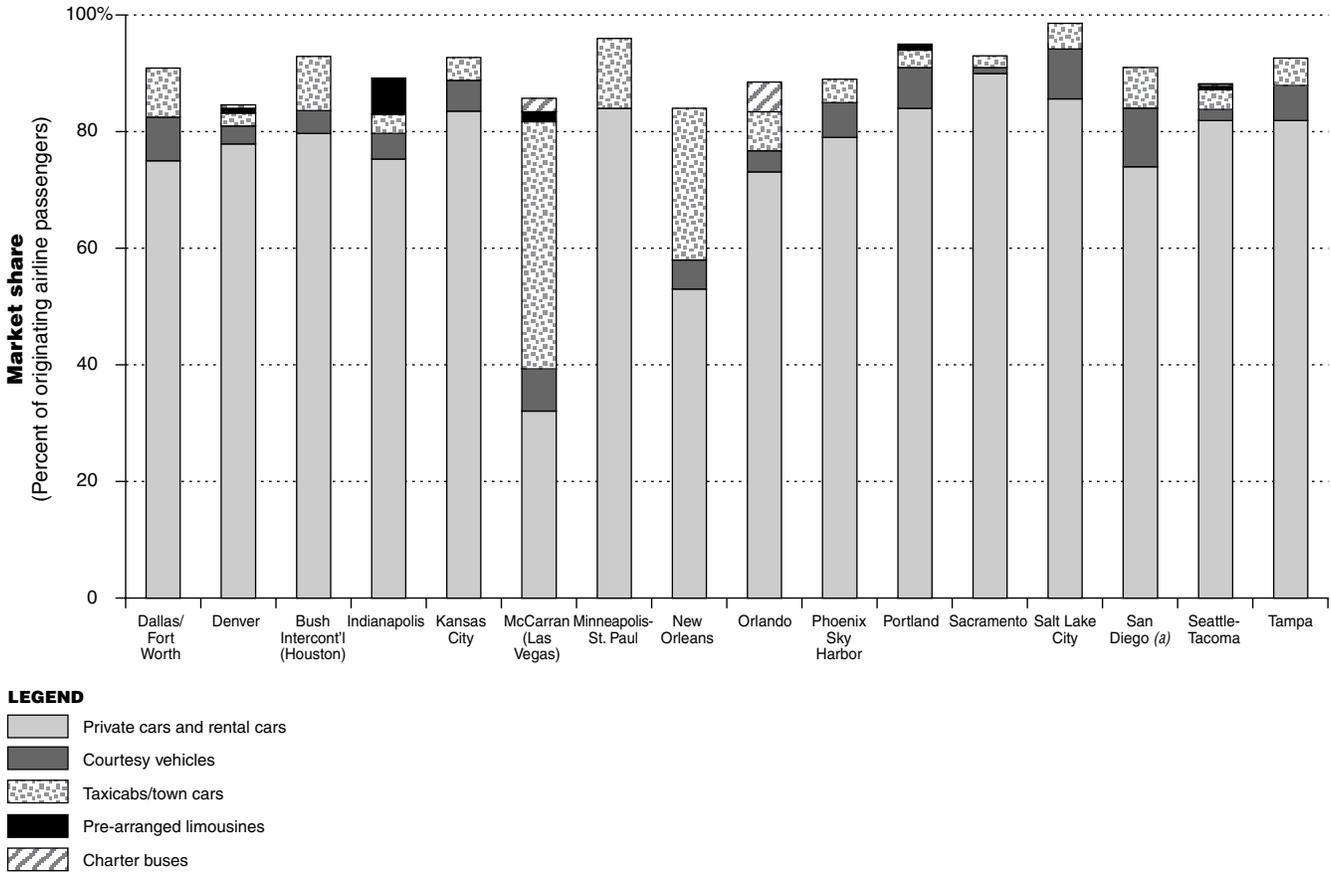
Hartsfield Atlanta Airport was constructed with a rapid transit station for the Metropolitan Atlanta Rapid Transit Authority (MARTA) in the arrival area of the airport’s landside terminal. The entrance to the rail station is closer to baggage claim than the taxi, limousine, and bus services at the airport. (In the United States, Cleveland Hopkins Airport has the only other rail station initially built as part of the air terminal.) The Atlanta transfer point is part of a highly centralized baggage-pickup area, with an escalator connection to the transit station above. In a 1997 airport survey, about

8 percent of originating air passengers arrived at the airport on the MARTA rapid transit service.

Because no formal survey was undertaken until 1997, information on the use of MARTA by airline passengers has been unavailable. In 1994, a MARTA survey of the station users concluded that 23 percent of the airport station transit users were airline passengers. An earlier survey indicated that 58 percent of the rail system users were air travelers in 1988, and 56 percent were air travelers in 1990 (2).

Figure 2-8 shows the boardings at the MARTA station by air passengers from 1990 to 1997, with 2,500 air passengers in 1990; 2,100 in 1992; 1,800 in 1994; and 2,500 in 1997. Given the airport growth over the past decade, even though the number of riders is the same, the overall mode share has likely declined since 1990.

MARTA’s market share is consistent with the high quality of connections that the system offers. The quality of service seems to be valued by users more than cost savings—in 1990, 54 percent of those surveyed said they chose MARTA for reasons of convenience; 24 percent said they chose MARTA because of cost savings. About 6 percent of those surveyed reported that they chose MARTA because they had no other options. Importantly, the survey showed that MARTA



(a) Courtesy vehicle share includes prearranged limousines.

Figure 2-6. Private/non-HOV market share patterns at large U.S. airports without rail service.

SOURCE: Leigh Fisher Associates, based on information provided by airport management.

was capturing the business traveler, with 82 percent of the weekday airline passengers on the train traveling for business or convention purposes. Only 16 percent of air traveler riders were taking a personal or vacation trip. Had the rail service not been available, 46 percent would have accessed the airport by car, and 36 percent would have accessed the airport by taxi or limousine. About 27 percent were going to CBD stations; 32 percent of riders would walk to their destination, while 28 percent would be picked up. Of rail users, 9 percent carried three or more pieces of baggage (3).

Chicago-O’Hare International Airport

The train station at Chicago-O’Hare Airport has the highest use rates of any U.S. on-airport transit station, with about 7,300 transit boardings per day. Of these boardings, surveys show that fewer than 20 percent are air travelers, with most of the others working at the airport.

According to CTA surveys, about 5 percent of air passengers use the CTA rail services to or from the airport. (Sur-

veys by the Chicago Area Transportation Study record about a 4 percent market share for rail.) There is little variation in rail ridership by air trip purpose, with business trip riders choosing rail at about the same rate as non-business trip riders. Rail was slightly more attractive to people going to the airport than from the airport. CTA analysts note that almost two-thirds of those arriving at the airport had local origins outside of the CTA service area; within the transit agency’s service area, air passenger rail market share was estimated at 15 percent (4).

In a 1990 survey, CTA services were found to be used more to the airport (5.8 percent) than from the airport (4.9 percent). The service is more often used by residents than nonresidents, with 21 percent of departing residents choosing rail. Although about 60 percent of air passengers are nonresidents, fewer than 20 percent of train users are nonresidents.

The train station is 1,000 ft walking distance from all terminals except the new international terminal, where a people mover trip is necessary. Although rail service has somewhat longer travel times than taxi service in off-peak hours, rail benefits from greater travel-time reliability during peak hours.

TABLE 2-3 Employee access mode choice for selected large U.S. airports

Access mode	Boston-Logan	Denver	Los Angeles	Phoenix Sky Harbor	Salt Lake City	Sacramento	Seattle-Tacoma
Private vehicle	79.3%	83.8%	97.2%	85.0%	94.0%	99.0%	89.0%
Express and multi-stop buses	4.4 (a)	14.2	2.5	1.7	5.0	--	2.0
Rail	12.2	--	--	--	--	--	--
Other (b)	4.1	2.0	0.3	13.3	1.0	1.0	9.0
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

NOTE: See Appendix A for survey dates for each airport.

(a) Includes Logan Express bus service.

(b) Includes airline crew vehicles.

SOURCE: Leigh Fisher Associates, based on data provided by airport management.

Boston-Logan International Airport

The rapid transit station at Boston-Logan Airport attracts more than 4,000 riders daily, approximately one-third of whom are air travelers. In 1996, the Boston’s airport rapid transit station attracted 5.7 percent of airline passengers to the system operated by the Massachusetts Bay Transportation Authority (MBTA).

As shown in Figure 2-9, rail ridership has been relatively stable over the past 30 years, with a slight decrease since 1990. With about 6 percent market share in 1970, the rapid transit market share increased to a high of 7.1 percent in 1990

and then decreased to 5.7 percent in 1996 (as determined by survey). Among the factors associated with the decrease in rail use has been an increase in the use of other types of public transportation, such as shared-ride vans. Scheduled buses now carry about 12 percent of the air passenger market at Logan. An additional 9 percent are carried by limousines, which are mainly nonshared, prearranged services.

The market for rail services in Boston has changed over the past 3 years. For most of the past 20 years, rail has offered a major travel-time savings over taxis or other modes during many of the peak hours. This advantage, however, has diminished as taxis now have the right to use the new Ted Williams

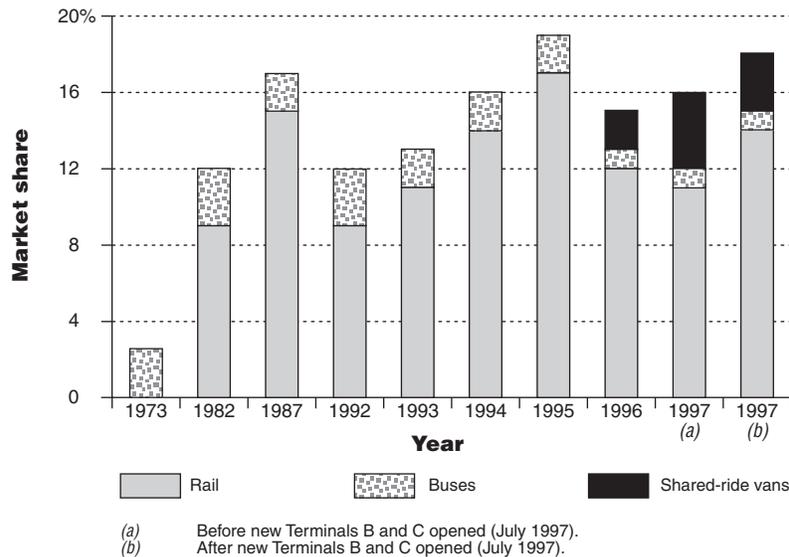


Figure 2-7. Market share trends of public transit accessing Reagan National Airport.

SOURCES:

For 1973: Spear, B. *Analysis of the Demand for Airport Bus Service at Washington National and Dulles International Airports*, Transportation Systems Center, Cambridge, MA, 1984.

For 1982, 1987, 1992: Washington Council of Governments. *1992 Washington-Baltimore Regional Air Passenger Survey, Volume 1: Principal Findings*, Washington, D.C., 1994.

For 1993-1997: Metropolitan Washington Airports Authority, 1997 Passenger Survey, conducted by Widener-Burrows & Associates, Inc.

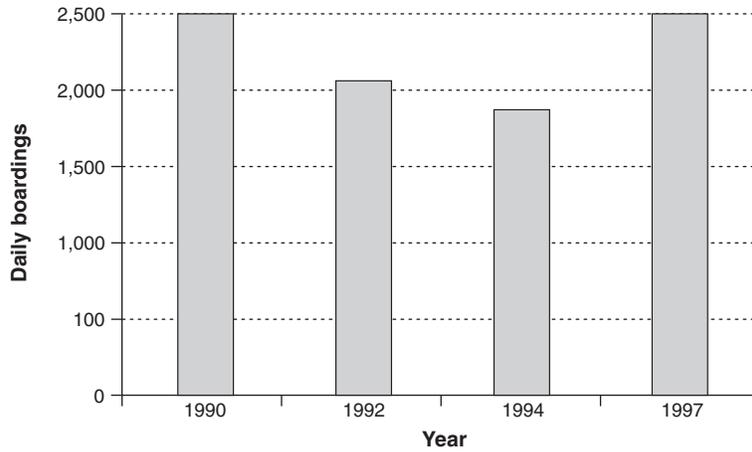


Figure 2-8. Trends in air passenger ridership at MARTA airport rapid transit station.

SOURCES: Metropolitan Atlanta Rapid Transit Authority, Service Monitoring Section.

Tunnel, in which general-purpose vehicles are not yet allowed. In 1997, rail ridership was down by about 8 percent (5). With this observed decrease in transit volumes since the most recent survey in 1996, Boston’s actual rail mode share is estimated to be somewhat lower than recorded in the 1996 survey (6).

In 1990, about 10 percent of airport employees used rapid transit to access the airport (7).

Within the total metropolitan market, the rail system has attracted a considerable market share in certain well-served geographic areas. In the CBD, the rail system has attracted as much as 22 percent. Residents have been a strong component of the rail ridership. During rush hours, the rail to downtown avoids long backups experienced by taxis.

Lambert-St. Louis International Airport

The light rail at Lambert-St. Louis Airport attracts about 3.3 percent of airport passengers, as determined from calculations, not surveys. About 2,400 transit riders board at the airport station daily, but no market survey has been undertaken concerning the split between passengers and employees. Both airport and transit officials, however, suggest that about one-third of the riders are air travelers, with most of the rest airport workers. These airport and transit managers have reported that nearby park-and-ride facilities have been filling up with airport employees anxious to avoid an airport parking charge recently established for most airport workers.

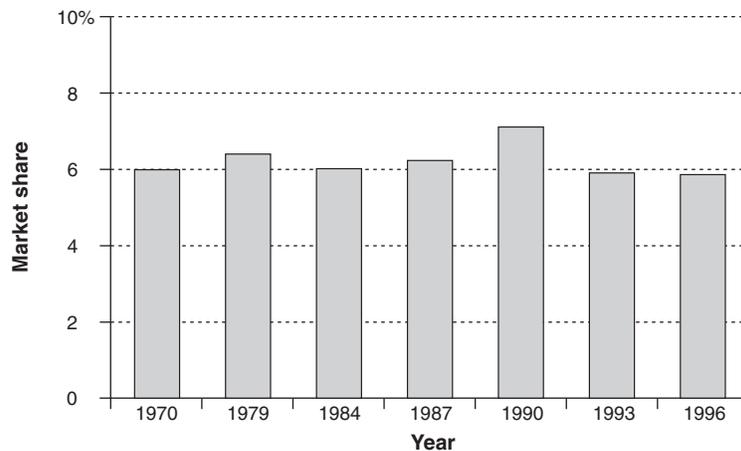


Figure 2-9. Rail market share trends at Boston-Logan International Airport.

SOURCE: MarketSense, based on data provided by the Massachusetts Port Authority.

The St. Louis light rail has been integrated into the interior spaces of the airport's Main Terminal; the passenger does not need to leave the terminal to access the rail system. A second station has been built to serve the East Terminal currently used by Southwest Airlines.

Cleveland Hopkins International Airport

Because the Cleveland Airport is located 10 mi from the downtown, with travel times that are directly comparable to taxi times (to the downtown Terminal Tower complex), the 30-min ride makes the Cleveland rail transit competitive with taxis. With 12- to 15-min headways, the service is one of the most frequent of rail services at airports located this distance from the CBD. The major difference is price—\$1.50 for rail versus \$17.00 for taxis (which gain about 5 percent mode split)—reinforcing the concept that most air travelers perceive convenience to be more important than cost.

Ridership has declined sharply over time, for reasons that have more to do with the perception of the service than the actual times and costs relative to competing modes. A 1970 airport access survey reported a rail market share of 19 percent, with the downtown's largest destination zone showing a 33 percent market share (8). However, average airport station volumes (all trip purposes) decreased 36 percent between 1970 and 1975. In 1988, the rail market share was estimated to be 2.8 percent.

Rail service at Cleveland Hopkins benefits from a well-designed passenger connection to the terminal, with short walking distances from baggage claim.

Philadelphia International Airport

In 1986, about 4.5 percent of originating air travelers chose the commuter rail service, a market share that has decreased to about 2 percent. At the time of the 1986 survey, rail captured about 16 percent of the air traveler market from the center of the city (9).

Philadelphia Airport's layout was designed for good connections to the commuter rail platforms, with baggage-pickup areas adjacent to the three rail stops. Walking distances from each of the baggage-claim areas to the adjacent platform of the commuter rail are among the shortest in the world. The 30-min travel time to a series of distribution stations in downtown Philadelphia can be competitive during congested roadway periods but not during off-peak conditions. The rail line goes to the center of downtown, serving the Market Street East complex.

The 30-min headway of the service is problematic: the user can spend more time waiting for the vehicle than onboard the vehicle. As a result, Philadelphia's rail service attracts only about 2 percent of the airline travelers. Although the airport commuter rail station attracts about 2,600 riders a day, it is

estimated that only 14 percent of these rail users are airline passengers.

Baltimore-Washington International Airport

Since the opening of light rail service in 1997, no formal survey of mode access to Baltimore-Washington Airport has been published. Interviews with key management officials there, however, suggest that the initial service has been valuable to many employees (particularly concessions employees), who benefit from a link between central locations and the airport. Currently, about 750 boardings per day are reported at the airport light rail station. Assuming that 20 percent of those riders are air passengers, 1 percent of air passengers use the light rail for airport access. Assuming that one-third of rail riders are airline passengers, the rail market share would be 2 percent.

MARKET TRENDS AND FACTORS AT U.S. AIRPORTS WITH RUBBER-TIRED ACCESS SYSTEMS

This section describes the rubber-tired access systems commonly serving airports, the airport ground transportation operating environment, measures used by airport operators to manage the provision of these services to the traveling public, and trends in the use of prearranged limousines, shared-ride vans, express buses, and multistop buses.

Classes of Rubber-Tired Airport Ground Transportation Services

At most large airports, passengers can select from a number of ground access services. Passengers may not clearly distinguish among these services because they offer a variety of travel costs (e.g., fares and parking fees, but excluding the operating and maintenance expenses a private vehicle owner typically incurs), levels of service (e.g., walking distances, level changes, comfort, safety, availability of seats and baggage storage, driver knowledge and assistance), and travel times (including the time spent waiting for the vehicle and at en route stops and travel time reliability). Figure 2-10 illustrates the generalized continuum in the cost of travel and passenger levels of service of the airport rubber-tired and rail access modes and highlights how these factors overlap. (It is recognized that in certain corridors and in certain communities the relationship between ground transportation access modes may differ from those illustrated.) Because of these overlaps, an airline passenger may not be able to clearly distinguish the differences among ground transportation services. The characteristics that distinguish the individual classes of service may be more apparent and of less concern

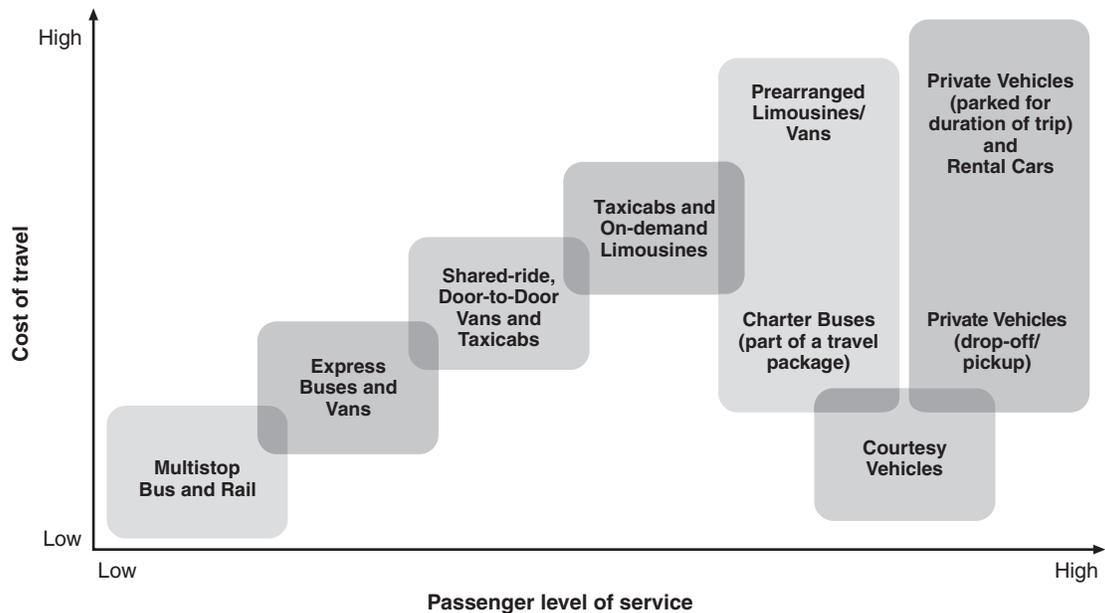


Figure 2-10. Comparison of classes of ground transportation.

to airline passengers than to ground transportation providers and airport operators.

For example, from a passenger's perspective there may be little difference among certain competing services because their distinguishing characteristics—such as type of license (or operating authority) or operator (e.g., public or private)—are less apparent than the scheduled travel time, advertised fare, or availability of exclusive or shared vehicle. However, the legitimacy of businesses providing competing services is very important to others (e.g., a ground transportation operator authorized to provide service to a designated market or to an airport operator responsible for passenger safety).

The following paragraphs describe the rubber-tired ground transportation services typically available at an airport. The first group of services (i.e., taxicabs and limousines) provides door-to-door service; the second group (i.e., shared-ride vans and taxicabs) offers door-to-door service on a shared-ride basis; and the third group (express and multistop buses) offers line-haul, fixed-route service.

Taxicabs

Taxicab services are well defined, and their advantages (e.g., door-to-door transportation at established fares) and disadvantages (e.g., concerns in some communities regarding driver courtesy and local knowledge or lack of service when there is a high demand elsewhere) are well known. Most cities establish maximum taxicab fares and restrict the number of licensed vehicles. Perhaps because taxicabs are locally regulated, politicians, as well as taxicab drivers and company owners, tend to be sensitive to changes affecting the taxicab industry.

Town Cars (On-Demand Limousines)

At some airports, on-demand limousine or town car services, which operate much like taxicabs, are available. These services have been introduced in response to concerns regarding the quality of taxicab service or by a taxicab operator seeking to gain market share from prearranged limousine operators.

Shared-Ride Taxicabs

Shared-ride taxicabs are also available at several airports. Typically the dispatcher forms customer groups with similar destinations and assigns them to a taxicab.

Prearranged Limousines (or Vans or Chartered Buses)

As the name of this service implies, passengers must make prior reservations to use prearranged transportation services (including charter buses or vans). Prearranged limousine services may include suburban taxicabs (i.e., licensed taxicabs, such as those from nearby towns, not authorized to pick up on-demand passengers at the airport). In most communities, the local operating authority establishes the geographic area of operation and the maximum fares or tariffs and prohibits the operators from responding to on-demand requests. Typically, there are fewer restrictions on the number of limousines serving a community than on the number of taxicabs.

Passengers perceive limousines as offering the highest level of service (door-to-door transportation and assistance with baggage) available at fares that may be cheaper for passenger

groups than some transportation services that charge a fare per passenger. However, passengers—including those holding reservations on scheduled services—cannot easily distinguish a properly licensed from an unlicensed limousine and may tend to accept offers from drivers improperly soliciting business at the airport. Customers who accept such transportation may find that they are overcharged or being transported in an uninsured or unsafe vehicle.

Corporations and other organizations (such as law firms) may provide private limousine transportation for their employees using company-owned vehicles or contract services. Typically, the driver will recognize the traveling party by sight. While these limousines are not available to the public, they are mentioned because it is difficult to distinguish these vehicles from on-call or prearranged limousines. It is necessary for airport management to be able to readily identify authorized vehicles to enforce rules and regulations restricting access to preferred curbside areas or passenger pick-up areas.

To ensure passenger safety, local regulatory authorities and airport operators attempt to prohibit unlicensed limousine operators from illegally soliciting business. However, enforcement of solicitation requires police officers to observe the actual solicitation and exchange of money and a clear definition of “prior” reservations versus on-demand service. For example, does a passenger calling a limousine service from the baggage-claim area reflect a prior arrangement? Other ground transportation operators, particularly taxicab drivers, are sensitive to the competition from limousine services. As discussed below, market trends indicate that the market share captured by prearranged limousine services has increased significantly at airports where taxicabs were perceived as offering poor or unreliable service, or where many passengers have origins or destinations in suburban towns with little taxicab service. These factors differ from those that have led to increased demand for shared-ride van service.

Shared-Ride Door-to-Door Vans

In some cities, shared-ride vans operate under taxicab licenses, while in other cities they operate under licenses (or permits) similar to the licenses issued to prearranged limousine and van or charter bus operators. Theoretically, while shared-van operators are limited to providing prearranged airport transportation (so as to distinguish the service from on-demand taxicab service), they offer on-demand service at most airports. Thus, the primary distinctions between the transportation services offered by taxicabs and shared-ride vans are the travel time (i.e., the number of en route stops), the fare, and need to share the vehicle with strangers.

In some communities, the licensing authorities do not limit the number of shared-ride van licenses (although the number of licensed taxicabs is restricted). In several states, the licensing authorities are not required to seek the airport operator’s input regarding the need for additional transportation service

prior to issuing a license to a new operator and may rely upon information provided by the applicant. However, because of a lack of adequate enforcement, licensed operators tend to serve the geographic areas with the highest demand rather than areas for which they were originally licensed.

As a result, in some communities would-be taxicab owners/operators who are unable to obtain a taxicab license, and others wishing to enter the airport ground transportation industry, often apply for and obtain licenses for shared-ride vans or limousines. Such operators, who have the legal authority to serve the airport, may be undercapitalized, offer no dispatching or marketing services, and use a vehicle licensed as a shared-ride van to operate like an unlicensed taxicab. As such, these operators adversely affect the taxicab industry (as discussed later), the legitimate shared-ride van industry (i.e., properly capitalized companies that offer dispatching and shared-rides both to and from the airport, and market the service they provide), and the scheduled bus industry (both publicly and privately operated). For example, in some cities, these operators have been known to arrive at a downtown stop just prior to a scheduled bus and offer to transport the waiting passengers.

Express Buses

Express bus services typically operate with limited or no en route stops. Such services are sometimes referred to as “air-ports” or limousines, although these services primarily use vans or buses. Examples of express bus services include those provided between airports and the CBD or downtown hotels, destinations outside the metropolitan area (e.g., scheduled service from Minneapolis-St. Paul International Airport to Iowa and South and North Dakota), or major tourist destinations. In some communities, the public transit agency operates express bus service between the airport and the CBD.

Multistop Buses

Traditional multistop, line-haul public buses are available at many airports. Such services are publicly operated and provide low-fare, fixed-route service. Typically, this service is the least expensive transportation service available at an airport and provides the lowest level of passenger convenience (no door-to-door service, no assistance with baggage, and no or limited baggage-storage space).

Airport Ground Transportation Operating Environment

Many of the private transit mode operators are small, locally owned businesses (even those displaying nationally recognized name brands) that are regulated by state or city authorities. Compared to other industries, entry into the airport ground transportation industry requires relatively little

training or investment in equipment or facilities. In many U.S. communities, the taxicab and limousine industries traditionally attract persons desiring jobs that require little training and offer a high degree of independence (e.g., flexible hours) and little direct supervision—persons who are often newcomers to the city.

Many of the private transportation companies have found that it is more lucrative to offer dispatching services, and, rather than use employee drivers, to use independent contractors who own and operate the vehicles in their fleets. For example, many taxicabs and shared-ride vans are operated by independent drivers who own their own vehicles and pay fees to a company for dispatching, insurance, or other services. The individual owner/operators may lease the vehicle to a second driver who operates it during late nights or weekends. Because the fares that can be charged are regulated, these arrangements may cause the driver or owner/operator to work longer hours, defer vehicle maintenance, or improperly solicit or overcharge customers in response to increasing costs (e.g., increasing franchise, fuel, insurance, or other costs).

Management of Rubber-Tired Transportation at Airports

Airport ground transportation operators, especially taxicab, limousine, and shared-ride van operators, may have little direct control over the behavior or actions of owners/operators or others leasing vehicles and providing service under their company's name. Similarly, local or state regulatory agencies that are often responsible for overseeing many industries (e.g., utilities, railroads, tow trucks) often have inadequate enforcement resources or powers. Thus, the airport operator may be required to become the de facto enforcement agency to ensure efficient operations and the safety and security of the traveling public using the airport. Some airport operators have assumed the responsibility for vehicle inspection, and many are responsible for enforcement of rules governing operator and driver behavior.

Airport operators use a variety of programs to control and manage ground transportation operations at their airports. The most fundamental element of such programs is the establishment of rules and regulations governing the operation of ground transportation services on the airport. All major airports have established rules that typically regulate (1) the vehicles (e.g., require that the vehicles be properly licensed, insured, and maintained); (2) the drivers (e.g., specify the driver's minimum qualifications, appearance, and behavior); and (3) where ground transportation vehicles can operate, stage, pick up, and drop off passengers. The regulations usually specify fines or penalties for infractions of these regulations.

Ground transportation providers are required to obtain an airport permit in order to pick up passengers at all large airports. By obtaining (and signing) the airport permit, ground transportation operators indicate that they (1) will abide by the established rules and regulations and (2) have entered

into a business relationship with the airport operator that allows them to do business (i.e., pick up passengers) on the airport. Typically, the ground transportation operator must pay a permit fee (charged by company or by vehicle). At many large airports, the ground transportation operator must also pay a fee intended to enable the airport operator to recover the costs associated with providing and maintaining the roadways and other facilities used by the ground transportation operators. Such fees often reflect the volume of business the ground transportation operators conduct at the airport and may be calculated as a percent of the operator's revenues (e.g., 15 percent of gross revenues) or on a per-trip basis (e.g., from \$0.25 to \$20.00 per trip).

Although all private ground transportation operators are required to pay such fees, public transit agencies are usually exempt from such fees. In fact, as described in later sections, federal regulations allow the airport operator to contribute to the cost of constructing public transportation facilities that are located on the airport and are used exclusively by airport passengers and employees.

The following paragraphs describe programs used by airport operators to manage ground transportation services.

Open Access

At many airports, any ground transportation operator can pick up passengers if the operator is properly licensed by the city or county operating the airport (or other appropriate authority). For example, at Bush Intercontinental Airport/Houston, all licensed taxicabs and limousines can pick up passengers. This program allows equal access for all operators wishing to serve the airport. However, the airport operator has less ability to control the number of vehicles serving the airport and the quality and operation of the vehicles and their drivers.

For example, with an open access system, the airport operator has limited ability to balance the demand for ground transportation services with the number of vehicles waiting to provide the services. When supply exceeds demand, drivers may wait several hours for a fare and thus receive fewer fares and lower revenue per day. When drivers are unable to cover their operating expenses, they are more likely to operate improperly (e.g., solicit rides, refuse short trips, or overcharge passengers). Conversely, when demand exceeds supply (e.g., on rainy days when there is high demand downtown), there may be insufficient taxicabs at the airport to serve arriving passengers.

Exclusive Concession Agreements

Several airport operators have entered into exclusive agreements with ground transportation operators. Shared-ride vans operate under an exclusive agreement at Phoenix Sky Harbor and Sacramento Airports. Taxicab, limousine, and scheduled-

bus services are operated in this manner at several airports, including those serving Boston (the Logan Express service), Detroit, Fort Lauderdale (taxicabs and town cars), New Orleans (express buses and vans), Orlando (express buses and vans), Portland (express buses), and Washington, D.C. (the Washington Flyer buses and taxicabs at Dulles).

Concession agreements are awarded through a bid or proposal process. Among other details, these agreements specify the level of service, fares, and hours of operation that the concessionaire (i.e., the operator awarded the contract) must provide. For example, the agreements may specify the maximum waiting times (or frequency of service), geographic service areas, stop locations, and number of stops en route. Under the terms of such agreements, the concessionaire is responsible for monitoring and enforcing rules controlling vehicles and driver appearance, behavior, and operations. The concession agreement allows the airport operator to consider and award a contract based on the quality of service a ground transportation operator agrees to provide, as well as the annual fees the operator guarantees to pay.

Exclusive concession agreements typically require that the airport operator ensure that the ground transportation operator is granted certain privileges (e.g., preferential curbside access) or the exclusive right to provide transportation to certain geographic areas, or both. For example, at Portland International Airport, one ground transportation operator has been awarded the right to provide express bus service between the airport and downtown. This arrangement effectively prohibits on-demand shared-ride transportation services to the downtown area, even though other classes of transportation service, including taxicabs, prearranged limousines and vans, and multistop buses, are available.

Taxicabs at airports in several communities (e.g., Pittsburgh) appear to operate as if they had an exclusive concession arrangement because a single taxicab company operates or controls most of the licensed taxicabs in the community.

Semiexclusive Concession Agreements

A variation of an exclusive concession agreement authorizes several operators to serve and compete for business at

an airport. For example, at Los Angeles Airport, three concession agreements were awarded to operators of shared-ride van services, with each operator agreeing to pay the airport operator a minimum of \$1 million per year for this privilege. Only these three shared-ride van operators are allowed to pick up on-demand passengers at the airport and transport them to certain areas (e.g., the downtown), although other shared-ride van operators are allowed to transport passengers to specific destinations outside the metropolitan area or pick up prearranged passengers. This business arrangement ensures that the passenger is offered competitive service and reduces the airport operator's dependence on a single company.

Agreements Based on Geographic Service Areas

At several airports (e.g., Baltimore-Washington, Newark, and Tampa), exclusive concession agreements have been awarded for specific geographic areas. At some airports, the selected ground transportation operator has a monopoly service; at others, the selected operator is granted certain privileges (e.g., preferential curb space) but still must compete for business.

Driver/Operator Consortiums

In response to the quality of taxicab or shared-ride van services, some airport operators have required (or encouraged) the formation of driver consortiums that are responsible for vehicle and driver inspection. For example, taxicab dispatching and enforcement at Seattle-Tacoma and Los Angeles Airports are the responsibility of such organizations. Until recently, similar organizations were responsible for shared-ride van management in Los Angeles and taxicab service in Honolulu, but they have been replaced because of concerns about a lack of enforcement capability (Los Angeles) and concerns raised by competitors (Honolulu).

Table 2-4 summarizes and compares the types of business arrangements described above.

TABLE 2-4 Rubber-tired transportation business agreement comparison

Type of business agreement	Ability to ensure a high quality of customer service	Ability to manage traffic operations	Typical "political" acceptability
None	None	None	Best
Open access	Limited	Limited	Good
Semiexclusive concession agreement	Good	Good	Poor
Geographic service area and driver/operator consortium	Good	Good	Poor
Exclusive concession agreement	Best	Best	Least

Trends in the Use of Prearranged Limousines

Door-to-door services are used by airline passengers seeking higher quality transportation. The increase in this market—which could be accommodated by either single-party or shared-ride services—is a major change in U.S. airport ground access patterns over the past decades.

This strong pattern of selecting an alternative mode at a markedly higher price can be seen in several U.S. markets. In New York, town cars have eroded the market share of both traditional bus service and taxicabs. In 1991, these services carried about 21 percent of all riders to the three New York–area airports combined—a share larger than taxicabs, rental cars, or scheduled buses. Paralleling the New York experience, Chicago-O’Hare has seen an increase in town car services from a 5 percent market share in 1977 to a 15 percent share in 1990. New York and Chicago airline passengers are showing a willingness to pay higher fees to buy a higher quality, “no-transfer” ground transportation service. This phenomenon is evolving primarily for lower occupancy, single-party service, in marked contrast to communities served by shared-ride vans.

Trends in the Use of Shared-Ride Vans

As noted above, airline passengers are choosing to purchase higher quality services, which arrive at their destinations without reliance on the rest of the public transportation system. Attempts to integrate their trips into systems essentially designed for commuter and work travel patterns have been less successful in the open marketplace. In many cities with well-designed rail transit facilities, riders are also attracted to services designed specifically for the needs of the airport user—services that match the unusual peaking characteristics of airport activity and that provide the more-direct connections desired by people with baggage. The preponderance

of these offer door-to-door service or service to common meeting places, such as suburban hotels.

At U.S. airports, strong market support exists for public transportation services tailored to the needs of the time-sensitive airport user, rather than to the needs of the price-sensitive daily commuter. A major public policy issue relates to the design and management of public transportation services intended to attract this market and thus increase system-wide ridership.

The following paragraphs describe trends in the use of shared-ride vans at airports.

San Francisco International Airport

The increase in door-to-door shared-ride van services to and from San Francisco Airport is an example of the market trend toward services that are higher priced than traditional public transportation operations. As shown in Figure 2-11, in 1985 shared-ride vans carried 3.4 percent of air travelers to the San Francisco airport; in 1990 and 1995, shared-ride van use had risen to 14 percent of the market. In 1997, the share was 12 percent. During this period, the use of scheduled bus operations between the airport and the CBD decreased sharply. The evolution of the San Francisco Airporter service from a terminal-to-terminal service (for which the company held an exclusive franchise) to a door-to-door service is significant. The success of on-demand, shared-ride, door-to-door services reflects the same pattern. The service concept of a ride to a common terminal, from which the user is expected to add a distribution mode (e.g., taxi), was largely replaced by the concept of door-to-door service, in which extra time is spent in the line-haul vehicle that provides the distribution service.

Currently, about 14 shared-ride van operators have permits to operate at San Francisco Airport, using about 285

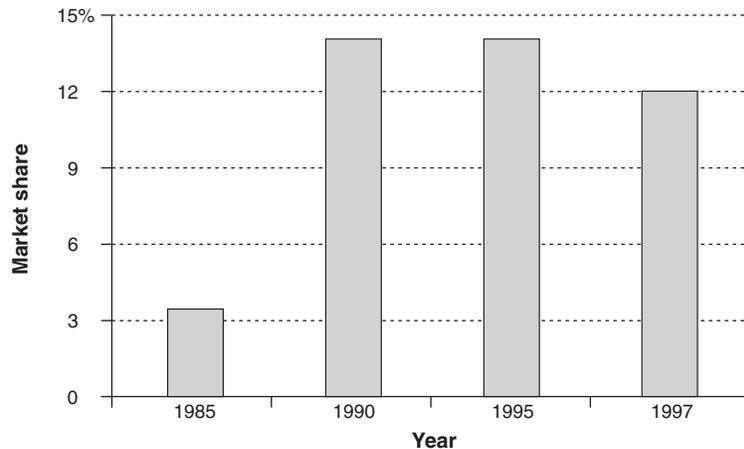


Figure 2-11. Trends in shared-ride door-to-door van service at San Francisco International Airport.

SOURCE: Leigh Fisher Associates, based on data provided by the Airport Commission, city and county of San Francisco.

vans and moving millions of passengers a year—about 12 percent of all air passengers—from the airport. In 1985, the average vehicle occupancy of the van operations (including the deadhead or nonpeak direction of service) was between four and five riders per trip. Again including the deadhead trips, taxis and luxury limousines average about 1 person per trip, with 11 persons per scheduled bus trip (10). Between 1996 and 1997, a sharp decrease was recorded in the overall vehicle occupancies of door-to-door van operations at the airport. The reported vehicle occupancy rate decreased from 4.0 in 1996 to 2.5 in 1997 (11).

Baltimore-Washington International Airport

Much of the marketing strategy at Baltimore-Washington Airport is directed toward capturing metropolitan Washington air travelers. Looking only at that market, the consumers' response to new ground transportation services has been encouraging. Ridership on the new Washington, D.C., door-to-door van services increased 125 percent in 1996 over 1995 ridership, with ridership in 1997 about 80 percent above 1996 levels. Door-to-door van service to Prince George's and Montgomery Counties increased 38 percent in 1996, with early 1997 volumes about 36 percent ahead of 1996 rates. Scheduled door-to-door van service to the downtown Washington, D.C., decreased 2 percent in 1996 compared with 1995 and was terminated in 1999 (12).

Boston-Logan International Airport

Until recently, Boston was following the pattern of New York, with strong growth in door-to-door van services operating as prearranged limousines for single parties. These private, prearranged services now account for 9 percent of Logan air passengers—a market share higher than the Logan Express. Boston, somewhat later than most U.S. cities, is beginning to develop a shared-ride-van market. The development of shared-ride, door-to-door services is largely occurring by companies already providing some form of scheduled services to and from the airport.

Recently changed Department of Public Utilities regulations allow ground transportation operators to provide service that is partly scheduled and partly on demand. These regulations now allow an operator to leave every half hour, serve three hotels, and proceed to deliver patrons directly to their door. This experience is similar to that at Baltimore-Washington Airport, where fixed-point terminals are being integrated with other door-to-door operations by the main concessionaire. Similar operations were reported in San Francisco, where long-haul scheduled services to major points (hotels) were continuing to provide some door-to-door distribution of passengers.

For regulatory purposes, Massport still considers these services to be scheduled. One van company has obtained oper-

ating rights in all the cities and towns served by the airport and has been very successful, carrying 18,000 passengers in a typical month in 1997 (13). The major operator of this door-to-door service prefers reservations 24 hr in advance for service to the airport but requires no prior reservations from the airport. For service from hotels, a combination of limited schedules and limited on-call services is in effect.

The Boston experience, similar to the Baltimore and San Francisco experiences, is just beginning to point the way to new service options, in which the higher fares charged for true door-to-door service may make scheduled service to lower trip-end-density locations more financially feasible. In all these situations, new flexibility has replaced older concepts about what defines scheduled service and what defines on-demand service. These new service concepts may be key to establishing acceptable service levels in situations of lower trip-end density.

Los Angeles International Airport

As shown in Figure 2-12, use of shared-ride vans at Los Angeles Airport increased from about 2 percent in 1987 to 5 percent in 1993. As described earlier, as part of a commitment to improve customer service and respond to regional efforts to comply with air quality standards, Los Angeles World Airports (LAWA) awarded three shared-ride van concession agreements. This program has significantly reduced the number of shared-ride vans allowed to pick up on-demand passengers at the airport and is expected to increase the occupancies in the shared-ride vans.

Trends in the Use of Express Buses

The following paragraphs describe trends in the use of express bus services at selected airports where such services are operated and data are available.

Boston-Logan International Airport

Over a 25-year period, policy makers in Massachusetts have been trying—with a remarkable level of success—to decrease the use of private transportation and to increase the use of public transit modes to Boston-Logan Airport. In 1970, 84 percent of airline passengers arrived at the airport in either a private car or a rented car; by 1996, that percentage had decreased to 48 percent. In 1970, fewer than 2 percent of air travelers arrived at the airport by scheduled bus. In 1996, 12 percent arrived by scheduled services, as shown in Figure 2-13 (14).

The tripling of market share by scheduled services is the result of many years of public agency participation, considerable operator investment, and public subsidy. Of the nearly 2 million riders a year using scheduled services to the airport, the majority of those travelers use the Logan Express

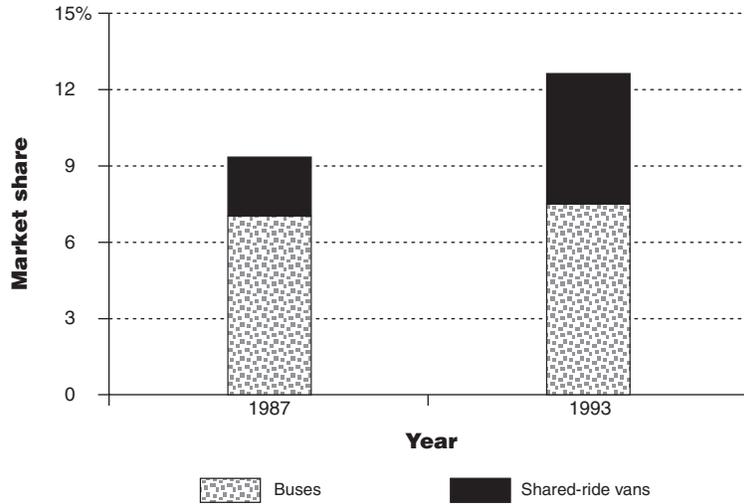


Figure 2-12. Market share trends in public transit access at Los Angeles International Airport.

SOURCE: Leigh Fisher Associates, based on information provided by Los Angeles World Airports.

bus service, which offers nonstop airport connections to three regional terminals located on or beyond Route 128.

The Logan Express service was designed and developed by Massport, not by the private sector. Today, the three routes together carry more than 1 million passengers, and the routes' revenues cover operating costs. Service from two suburban locations—Braintree, about 12 mi from downtown, and Framingham, about 20 mi from downtown—began in 1986, after a decade of planning and negotiations to obtain the rights to the two terminal locations. A third route, from Woburn, was opened in 1992 and, after initially low ridership, has established a considerable ridership base. In 1996, about 400,000 riders came from Braintree, 335,000 from Framing-

ham, and 195,000 from Woburn. Early 1997 figures showed a 13 percent increase for Braintree, a 5 percent increase for Framingham, and a 13 percent increase for Woburn. In 1999, construction was under way for a new Woburn intermodal transfer station, which will include a new rail station served by direct ramps from the Interstate. Additional services are being planned for the North Shore and Cape Cod (15).

Los Angeles International Airport

To Los Angeles Airport, LAWA operates one express bus route, called the Van Nuys Fly Away, which is longer than

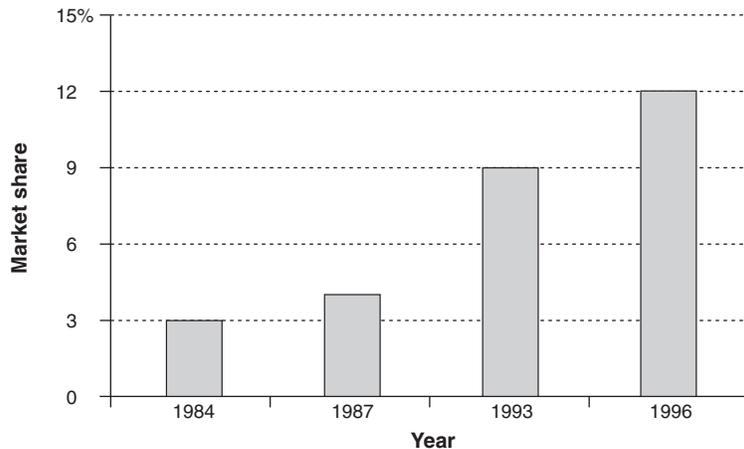


Figure 2-13. Bus market share trends at Boston-Logan International Airport.

SOURCES: The Massachusetts Port Authority, Central Transportation Planning Staff, and Matthew A. Coogan.

any single Logan Express route but shorter than the total three-route system. In its peak ridership year (1998), the Van Nuys Fly Away attracted 717,900 passengers, or just about twice as many riders as Logan's Framingham service (16). The Van Nuys terminal is about 21 mi from the airport, and service takes about 1 hr. Service is similar in scope to the Boston service, with 30-min headways all day, except in the A.M. peak period, when headways are 15 min. While Boston offers after-midnight riders a free taxicab, the Los Angeles service offers 1-hr headways after 1:30 A.M. The service operates more than 2,000 spaces at the Van Nuys terminal location.

LAWA attempted a second operation, considerably closer to the airport, in West Los Angeles. After a 3-year trial, the facility was closed because of low ridership. Airport staff have suggested that the facility was too close to the airport to attract private-vehicle users to the service.

Dulles International Airport

The Washington Flyer bus service from Dulles Airport offers express service to downtown. The bus service is operated using over-the-road coaches, with adequate baggage capacity. The service benefits from the availability of HOV lanes on I-66 and the Dulles Airport Access Road (the exclusive, limited-access expressway linking the freeway system with the airport). Ticket counters, staffed by the bus operator, and waiting areas are available inside the terminal building.

As shown in Figure 2-14, the market share for the Dulles express bus service has been decreasing for two decades, from 15 percent in 1978 to 9 percent in 1982, 5 percent in 1994, and 4 percent in 1997. During this time, the market area served

by the Dulles airport has shifted from an emphasis on downtown Washington to a Northern Virginia market, influenced by the increasing airline service available at the airport. Still, given the combination of HOV, preferential treatment at curbside, and cost of alternative modes (e.g., taxicab or limousine), the decrease in market share is difficult to explain.

San Francisco International Airport

The Marin Airporter express bus service was developed by private entrepreneurs, who have successfully operated the service between Marin County (located across the Golden Gate Bridge, north of San Francisco) and San Francisco Airport. Consistent with other successful long-distance bus routes, the Marin Airporter operates from the airport every half hour from 4:30 A.M. to midnight. The 28-mi trip takes about 50 min under normal traffic conditions. The one-way fare is \$10 from the terminal facility and \$14 for stops north of the facility. Ridership for the immediate service area has been estimated at near 20 percent of airline passengers (17). Other scheduled services from San Francisco Airport are provided to Napa County and San Jose. Scheduled buses are used by about 5 percent of airline passengers.

LaGuardia, JFK International, and Newark International Airports

Bus service designed for and dedicated to airline passengers has been a major public transit mode at the three New York-area airports. At LaGuardia, privately owned buses

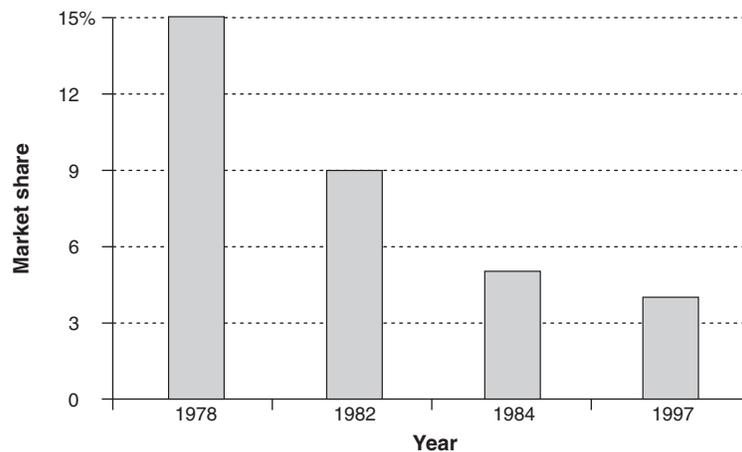


Figure 2-14. Express bus market share trends at Washington Dulles International Airport.

SOURCES:

Spear, B. *Analysis of the Demand for Airport Bus Service at Washington National and Dulles International Airports*, Transportation Systems Center, Cambridge, MA, 1984.

Washington Council of Governments. *1992 Washington-Baltimore Regional Air Passenger Survey, Volume 1: Principal Findings*, Washington, D.C., 1994.

Leigh Fisher Associates, based on data provided by the Metropolitan Washington Airports Authority.

captured 7 percent of the market in 1992 and 5 percent of the market in 1997. At JFK, privately owned bus service captured 8 percent of the market in 1992 and 1997. At Newark Airport, use of privately owned airport buses has risen from 5 percent in 1992 to 7 percent in 1997. Privately operated express bus services link LaGuardia and JFK with Midtown Manhattan, as well as major hotels. At Newark Airport, express bus services are operated by both New Jersey Transit (to the Port Authority Bus Terminal in Manhattan) and by private operators to lower Manhattan (18).

gers captures about 6 percent of the air-passenger market, the services provided by the local transit agency capture only about 1 percent of that market. A 2.7 percent market share for the local bus was reported for Phoenix Sky Harbor Airport. Market shares of about 1 percent are reported for airports serving Minneapolis; Tampa; Portland, Oregon; and Philadelphia.

The following paragraphs describe trends in the use of multistop bus service at selected airports where such data are available.

Trends in the Use of Multistop Buses

There are many examples of well-designed transit bus services to U.S. airports, including Seattle’s innovative use of its downtown distribution tunnel and network of HOV lanes. Although the bus service designed specifically for air passen-

Denver International Airport

In Denver, the Regional Transportation District (RTD) has adopted an aggressive program of providing bus service to Denver Airport. This service currently captures a 3.5 percent market share of air passengers. As shown in Figure 2-15, the Denver RTD SkyRide Service is unique in that it provides

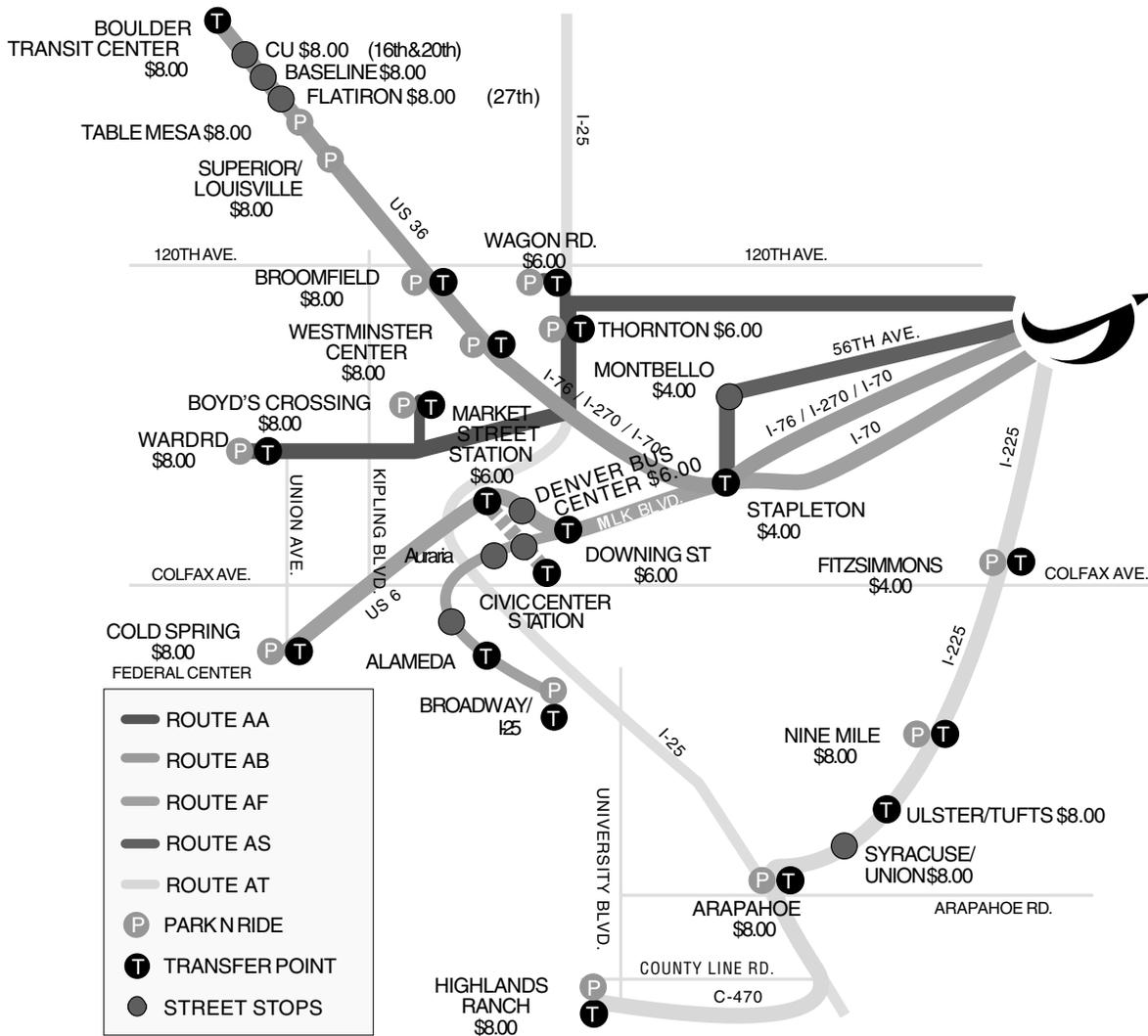


Figure 2-15. Denver Regional Transit District’s Skyride Service.

SOURCE: Denver International Airport website (www.flydenver.com/skrid.pdf).

direct service to several major activity centers, not just to the CBD. As shown in Figure 2-15, the transit agency currently operates five routes providing transit access to the new airport.

The SkyRide Service is operated to serve the work schedule of airport employees, with early morning and late-night service. Toward the airport, service is operated from 3:20 A.M. to various hours ranging from 8:20 P.M. to midnight, depending on the route. From the airport, the service leaves generally between 6 A.M. and 1 A.M. The full fare for a one-way ticket is \$8. The service attracts about 3,900 riders per day. Currently, the service attracts a market share of 6 percent of residents and 1 percent of nonresidents.

The RTD service captures 11 percent of the airport employee market, with about 14 percent taking the bus to work. The RTD calculates that many workers find another mode, such as car-pool, to return home (19).

San Francisco International Airport

The most recent passenger survey (1998) indicates that multistop bus services attract 4 percent of airline passengers at San Francisco Airport, which is double the 2 percent market share reported in 1995 surveys. These results are comparable to the level of transit use at the airport in 1975 and 1980. Significant improvements to the connections to Caltrain and the new SamTrans connection to Colma Station could be responsible for an increase in ridership. SamTrans continues to operate its local bus service to the downtown San Francisco bus station. This route offers low fares (near-\$1 fare), but the service is slow, and riders with baggage are not encouraged to use the service.

DETERMINANTS OF PUBLIC TRANSPORTATION MARKET SHARE

This section describes the key factors affecting airline passenger and airport employee use of public transportation access modes. The factors were determined through (1) a review of service at U.S. and international airports with rail service, and (2) surveys of U.S. airport operators (see Appendix A). The key factors appear to be

- Orientation to the CBD,
- Employees as a market for public transportation services,
- Quality of service and level of convenience, and
- Competition between transportation services.

Orientation to the Central Business District

The proportion of airline passengers with trips beginning or ending in the CBD, downtown area (the area traditionally well served by transit), or other major activity center has a major influence on the ability of rail services to attract significant market share. The market share is affected by (1) the

proportion of airport passengers having trip ends in the downtown area and (2) the quality of the transit connection between the airport and the downtown area.

Shares of Airline Passengers with Trip Ends in the Downtown Area

Although passengers traveling through a few U.S. airports have a strong orientation to nearby downtown areas (consistent with the patterns found in many European cities), at most U.S. airports, dispersed trip origins or destinations represent a significant challenge for successful rail operations.

In the United States, a small number of airports have a passenger market that is strongly linked to the nearby downtown area. As shown in Table 2-5, these airports include LaGuardia, John F. Kennedy, and Reagan National.

In Europe, several airports have markets that are heavily oriented to the downtown area, including Paris (with 60 percent of the airline passengers traveling through Charles de Gaulle Airport and 50 percent traveling through Paris Orly Airport going to downtown), Oslo (with 48 percent of airline passengers going to the downtown), and London (with 35 percent of the passengers traveling through Heathrow Airport going to London).

Quality of the Connection Between the Airport and Downtown

As noted, the downtown area is typically well served by traditional transit services in the United States. Most U.S. transit systems are configured to respond to the needs of cost-sensitive, daily commuters and are thus radial systems oriented to the downtown area. Often one “spoke” or route of the transit system extends to the airport, linking the airport with the downtown area.

However, most U.S. airline passengers have trip ends in areas located outside the downtown area and outside the area well served by transit. To travel to these areas, airline passengers often need to make one or more transfers. This can discourage the use of transit, especially for passengers who have several pieces of baggage or who are traveling in a large family group.

Typically, CBD rail stations and vehicles are designed for daily commuters, not airlines passengers. It is often difficult for passengers with large pieces of baggage or small children to negotiate turnstiles or climb the stairs or escalators in these stations. It may be difficult to safely store large bags aboard a transit vehicle. Even if an airport station is designed to respond to these concerns, it is unlikely that an entire transit system (stations and vehicles) would be designed for airline passengers.

An analysis of Chicago’s O’Hare Airport indicates that between 60 percent and 65 percent of airline passengers come

TABLE 2-5 Share of airline passengers with trip ends in the downtown area

Airport	Percentage
LaGuardia	46%
John F. Kennedy International	32% (to Manhattan)
Reagan Washington National	33% (to central Washington, D.C.)
Midway	20%
Baltimore/Washington International	14% (to central Baltimore)
Newark International	14% (to Manhattan)
O'Hare International	14%
Philadelphia International	14%
Washington Dulles International	12% (to central Washington, D.C.)
Hartfield Atlanta International	7%
Denver International	20% (of nonresident, business passengers)

SOURCES:

LaGuardia: Port Authority of New York and New Jersey Survey, 1985.

Heathrow: BAA (formerly British Airports Authority) Market Research.

Reagan National: Washington Council of Governments, *1992 Washington-Baltimore Regional Air Passenger Survey, Volume 1: Principal Findings*, Washington, D.C., 1994.

JFK: Port Authority of New York and New Jersey Survey, 1985

Midway: Chicago Transit Authority, 1994

Boston-Logan: Central Transportation Planning Staff, 1987

San Francisco: Harvey, 1988

Baltimore-Washington: Washington Council of Governments, *Geographic Findings*, 1994;

Newark: Port Authority of New York and New Jersey Surveys, 1985

O'Hare: Chicago Transit Authority Ground Travel Survey, 1990

Philadelphia: Wilson Hewitt & Associates, 1986

Dulles: Washington Council of Governments, *Geographic Findings*, 1994

Los Angeles: Survey by Wilbur Smith and Gardner & Holman; 1987

Denver: Denver Region Council of Governments, 1997

Atlanta: Larrabee and Schepps, *Airport Ground Side Access Study: Urban Mass Transportation Administration, Office of Planning 1991*. Reported from 1988 Survey.

from beyond the regional transit service area. Thus, although the CTA serves only 5 percent of all airline passengers, it is used by 15 percent of airline passengers with trip ends in the CBD. A similar distribution occurs in Boston, where 61 percent of the resident airline passengers came from the outer suburbs area not served by the regional rapid transit system.

In the United States, specialized services have been developed to respond to these specific markets not well served by traditional transit services. These services include the express bus services operated at the airports serving Boston (Logan Express), Denver (employee-oriented SkyRide), Los Angeles (Van Nuys Fly Away), and San Francisco (Marin Airporter). None of these services rely upon the general-purpose transit configuration of the metropolitan area. In each case, the specific needs of the target market segment were defined and provided for. In general, each of the transit services was able to attract about 20 percent market share in its immediate service area.

Employees as a Market for Public Transportation Services

As noted in prior sections, airports are major employers with more than 10,000 employees working at some airports. This employment base represents a potential source for transit

ridership, with several airports reporting rail mode shares of about 10 percent including Chicago-O'Hare, Boston-Logan, Hartsfield Atlanta, Cleveland Hopkins, and JFK. Higher uses of transit (bus or rail) by employees have been reported at LaGuardia (18 percent), Newark (17 percent), and Denver (14 percent) Airports. The Denver Regional Council of Governments shows that the bus market share is 4 percent and suggests that the airport ridership appears to be a direct function of income level. Strong bus mode splits (18 percent) are reported for those traveling between 4 A.M. and 6 A.M.—stronger than in many midday periods (20).

European transit shares for employees are generally similar to the U.S. experience, with 14 percent reported for Amsterdam's Schiphol Airport, 5 percent for Cologne/Bonn International Airport, 15 percent for Frankfurt International and Hamburg Airports, and 4 percent for Manchester Airport. London's Heathrow Airport reports 12 percent of employees use public transit modes, with 6 percent taking the Underground.

In the U.S., employee use of transit is affected by

- A lack of transit service to the major employment centers on the airport (e.g., airline maintenance facilities or air cargo sortation facilities).
- A lack of transit to the areas and neighborhoods in which employees live, which are often in the opposite direction

from the downtown area and thus typically not well served by transit.

- Reduced transit service at nights and on weekends, as many airport employees do not work traditional hours.
- Concerns of employees working late-night shifts regarding safety at both the airport and non-airport ends of the trip.
- The availability of low-cost or free parking for employees (often required as part of labor agreements) on or near the airport. However, some entry-level, low-wage employees do not have access to private vehicles. The availability, cost reliability, and travel time offered by transit are important considerations in the ability of these employees to accept employment at an airport.

Quality of Service and Level of Convenience

Key factors affecting quality of service are differential travel time and travel cost, walking distances and level changes at both ends of the trip to and from the airport, and availability of parking. Travel time between the airport and major destinations reflects the frequency of the service (and long waiting times) and the need to make multiple transfers. At large airports, with multiple passenger terminal buildings, passengers must either walk to a central stop, endure numerous en route stops, or use an intermediate mode (e.g., an automated people mover) to travel between the terminal and the station. Frequent travelers and other passengers concerned about the need to anticipate unforeseen delays caused by highway congestion recognize the value of reliable travel times offered by rail (versus rubber-tired access modes).

In most U.S. cities, public transit offers a cost savings compared with taxicabs or other on-demand services. However, certain transit modes can be perceived as being expensive, especially for family groups, compared with the perceived cost of using a private vehicle. This concern can increase if in-expensive and convenient parking is available. (However, in at least one city, travel to the downtown area via rail is more expensive than via taxicab, and the waiting time for rail can be as long as the entire taxicab ride.)

There are relatively few examples of good “before-and-after” data to illustrate the relationship of service quality factors to the use of public transportation. Significant changes in access quality have occurred at Reagan National Airport with the reconfiguration of the terminal area, and at Boston-Logan Airport, with the creation of a new HOV system.

The reconfiguration of Reagan National, with construction of the new main terminal adjacent to the Metrorail station, seems to have had a positive effect on rail mode share. Before the reconstruction, the Metrorail captured about 11 percent of the market; after the reconstruction, the Metrorail captured nearly 14 percent of the market. The cap on the number of

aircraft operations at the airport, which has tended to divert passengers from areas not well served by Metrorail to Dulles and Baltimore-Washington Airports, is also a contributing factor.

Market conditions improved for the Logan Express’ Braintree service when both a new express bus lane and a new tunnel serving the airport were opened. Braintree Logan Express’ average daily ridership increased 50 percent as a result of the new radial bus lane, the commercial-vehicle-only tunnel, coordinated HOV policy, and other factors.

The Washington, D.C., before-and-after example can also be used to illustrate the difficulty in analyzing long-term market patterns from small amounts of data. The same survey program that recorded an increase in ridership also recorded that in 1995, during the construction disruption that made access to the station difficult, the Metrorail captured over 16 percent of the airline passenger market. Looking only at these two observations, it could be reported that present mode share (with the new terminal) is lower than that experienced during the construction period. The higher market share may have been influenced by the availability of convenient parking at the airport during the construction period. This case study demonstrates the difficulty of observing market trends, which take years to develop, from relatively small survey samples, many of which were designed for purposes other than the analysis of airport ground access.

From the market data presented in the preceding sections, it is possible to build a case that good airport terminal and station design and good passenger levels of service are positively correlated with higher public transit ridership patterns. An earlier study of European airport access showed that airports with centralized terminal buildings, shorter walking distances, and good line-haul services had better public transit market shares than those with lower levels of passenger service. However, many other factors, such as the level of competition by other transit modes, are important. The managers of the Hong Kong Airport Express underestimated the aggressiveness of the local (privately operated) bus companies, with the result that 36 percent of the air-passenger market arrives by bus versus 24 percent by the new rail line.

Competition Among Transportation Services

Another key challenge is the preference for competing public transportation services, even when rail transit service is available. At London’s Heathrow Airport, although 25 percent of the airline passengers choose rail, about 15 percent choose bus. After a careful analysis of the ridership patterns of the subway, London Transport added an airline passenger-oriented bus to compete against its own subway service. Surveys by the British Airports Authority have shown that the same proportion of visitors to the United Kingdom choose

bus service as choose rail. In Paris, airline-run bus service is designed to compete with the significant rail investment at both airports. Increasingly, even the most rail-oriented airports, such as London Gatwick and Zurich, now have shuttle buses serving downtown hotels, which compete with the well-established rail services. Tokyo-Narita International Airport offers patrons one of the widest assortments of rail services available at any airport. Yet, although most airline passengers at Narita preferred rail (36 percent arrive by rail), 23 percent arrive by bus.

In Hong Kong and London, the need for rail passengers to transfer to a second mode to complete their trip (e.g., a taxicab from the Hong Kong Airport Express station or to the London Underground) may encourage the use of bus service. In the U.S., the availability of shared-ride, door-to-door services has influenced the use of scheduled buses and rail service, as described in separate sections of this report. Competition occurs not only between publicly operated bus and rail services, but also between publicly supported bus or rail services and privately operated bus, van, or taxicab services.

CHAPTER 3

A MARKET RESEARCH APPROACH TO PLANNING PUBLIC TRANSPORTATION SERVICE TO AIRPORTS

This chapter outlines a method for identifying, classifying, and understanding the airport user on the basis of his or her ground access trip to and from the airport. This information is important for planning and implementing all types of public transit systems to an airport because it focuses on the airport user. The method is an example of “airport market research” in contrast to “air travel market research,” and it is based on a different perspective from that used by the airlines in researching their customers. Classifying airport users according to factors that affect their ground access decisions helps in understanding how the attributes of public transit service can affect patronage by different groups. With sound market research and planning, a fixed guideway service to an airport can be positioned so that it represents an attractive access alternative to significant groups of airport travelers.

Market research is used in all sectors of today’s economy to identify and target selected markets, to gain a competitive edge, to classify and retain customers, and even to determine the lifetime value of selected customer groups. With an ever-increasing number of products and services, the consumer market has become highly fragmented. Increasingly, it has become important to identify and target selected groups of customers rather than trying to serve the entire market. Today’s consumer is studied, consulted, classified, and pursued with great persistence. Gaining the competitive edge sometimes means having the key piece of information that allows a service or product target a specific market segment.

Market research can be particularly important in planning public transportation to an airport. The need for market research is beginning to be recognized by various individual transit authorities, airports, and other public service providers throughout the United States. FTA and others are funding a variety of studies concerned with market research for public transportation (21). Airport ground access travelers are but another potential market for public transit that needs to be researched and classified. Market research will provide a new understanding about the access needs of airport customers.

CHARACTERISTICS OF THE AIRPORT GROUND ACCESS MARKET

The airport ground access market is the product of air travel. Continuing increases in air travel have made the need for ground access service to an airport more important. To

begin a discussion about the airport ground access market, terms must be defined. The term *ground access traveler* will be used to describe any air traveler or airport employee who travels to or from an airport by a mode other than air. This term cannot be applied universally to all air travelers. Those air travelers transferring between two different flights (who do not leave the airport) are not candidates for ground access services. As noted in Chapter 1, there is wide variation among airports in the proportion of originating (ground access) versus transferring air passengers.

Originating air travelers and airport employees are clearly the most important groups to consider for ground access purposes because they account for the majority of person trips to and from an airport. In many cases, the access needs of these two groups of ground access travelers are very different. The air traveler is on the first or last segment of a long-distance, multimodal trip, whereas the airport employee is commuting to work. However, it is in the commonalities of the air travelers’ and airport employees’ trips to the airport where significant markets for ground access services can be found.

Air Travelers

Air travelers can be classified according to many variables. As discussed in Chapter 2, two variables—trip purpose and home residence location—are used to classify air passengers for purposes of airport ground access planning. The combination of these two variables results in four market segments: resident business, resident nonbusiness, nonresident business, and nonresident nonbusiness.

Airport Employees

The second important group of ground access travelers is airport employees. Much less is known about this group of regular airport travelers. The 24-hr operation of a large U.S. airport is similar in nature to the operation of a small city because the airport has a multitude of functions, supportive of both the aviation activity and of the air travelers who use the facilities. For large U.S. airports, the total number of airport employees can be significant. In Table 1-1, the average daily number of employees is listed for 18 airports. The number varies from a low of 2,600 employees at San Diego Airport to

48,000 employees at Dallas/Fort Worth Airport. Because of variations in the schedules of airport employees, there may be a significant difference between the total number of airport employees and the daily number of employee person trips to and from the airport. Therefore, daily employee trips to an airport should be used when developing estimates of total daily ground access trips to an airport.

Many types of employees are needed to maintain the daily operations of a large U.S. airport. In addition to those individuals directly employed by the airlines and the airport operator, there are airport tenants such as freight forwarders and concessionaires. The work schedules of airport employees are highly varied and can change on a regular basis.

Geographic Distribution of Ground Access Trips

Knowing the distribution of air passenger and employee trip origins is critical to the planning of any successful public transportation service to an airport because these passenger origins represent potential customers for the planned service. An important consideration about ground access traveler origins is whether the location is a place of residence (home-based) or one of the many nonresidential locations (non-home-

based). The reason for making this distinction is the availability of private vehicles from residential locations.

Trip origins of resident air passengers and airport employees are likely to be dispersed throughout the region associated with the airport being studied. As illustrated by the map of Boston-Logan Airport's market area in Figure 3-1 (in conjunction with Table 3-1), the ground access trips of air passengers and employees can originate from a large geographic area. Table 3-1 divides the geographic market for Boston-Logan into three rings around the airport: 15 mi, 40 mi, and greater than 40 mi. The third ring includes ground access trips originating in a number of adjacent states. Each of the three rings contains zones of various sizes.

There are only two significant concentrations of ground access trip origins in individual zones—nonresident air travelers from Boston (11 percent) and airport employees coming from an area immediately to the north of the airport (12 percent). Resident business and nonbusiness passenger origins are dispersed throughout the region. About 18 percent of all origins are from a distance of 40 mi or more from the airport.

Non-home-based origins of ground access trips are likely to be concentrated in city centers, business locations, and areas with known attractions for visitors. In most cases, it is nonresidents or visitors to a region who begin ground access trips from locations such as these.

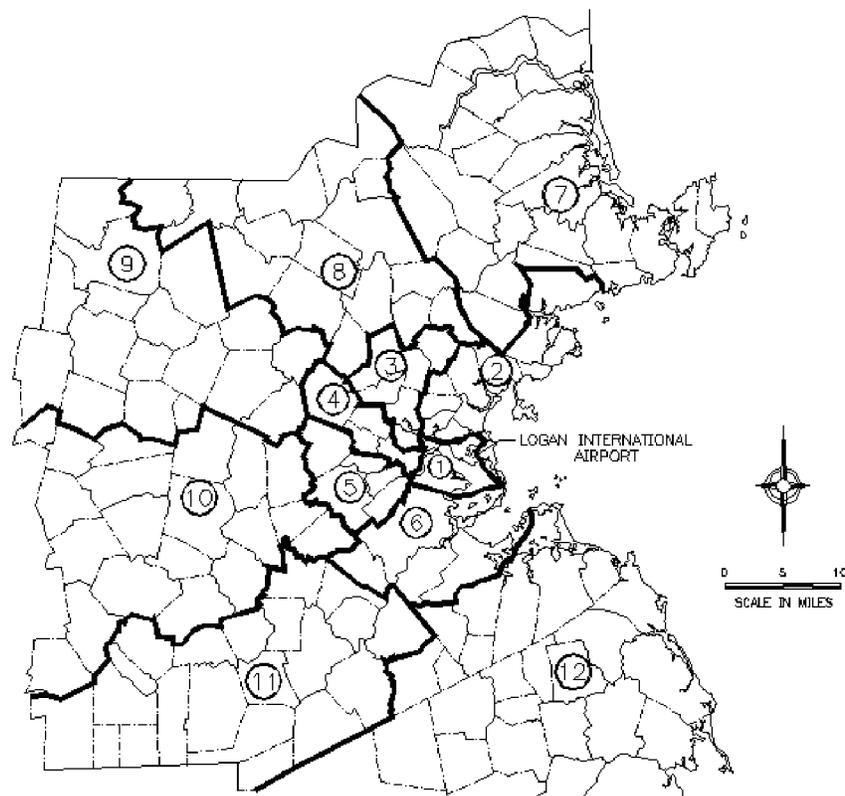


Figure 3-1. Geographic zones of eastern Massachusetts.

SOURCE: 1996 Logan Air Passenger Survey.

TABLE 3-1 Boston-Logan International Airport 1996 ground access trip origins

Approx. dist. from airport	Zone number	Zone location	Air passengers-residents	Air passengers-nonresidents	Airport employees	Airport employees and air passengers combined
0 to 15 miles	1	Boston	5%	11%	1%	17%
	2	North	3%	1%	12%	16%
	3	Northwest	2%	1%	1%	4%
	4	West Northwest	3%	3%	< 1%	6%
	5	West	4%	2%	1%	6%
	6	South	2%	1%	2%	4%
16 to 40 miles	7	North	3%	1%	2%	6%
	8	Northwest	3%	2%	1%	6%
	9	West Northwest	1%	1%	< 1%	2%
	10	West	4%	2%	< 1%	6%
	11	Southwest	2%	< 1%	< 1%	2%
	12	South	3%	1%	2%	5%
> 40 miles		Rest of MA, CT, RI, ME, NH, VT	11%	5%	3%	18%

MA = Massachusetts

CT = Connecticut

RI = Rhode Island

ME = Maine

NH = New Hampshire

VT = Vermont

NOTE: Approximately 37,900 air passengers and employees traveled to Logan Airport on an average weekday in 1996.

SOURCES: 1990 Logan Airport Employee Survey; 1996 Logan Airport Employee Survey.

If ground access trip origins of large U.S. airports were displayed on a map, it would show that the supporting market area for each airport is spread over a wide region. The exceptions to this might be regions with multiple large airports or specialized markets, such as the region served by Las Vegas McCarran Airport.

There is information available about the geography of market areas for U.S. airports from the 1995 American Travel Survey. The survey, conducted for the Bureau of Transportation Statistics by the U.S. Census Bureau, provides detailed information about the characteristics of long-distance travel (i.e., trips of 100 mi or more). The survey is conducted using a series of home-based interviews concerning all long-distance trips made by each member of the sample households. For air travel, the mode of access to the origin airport is given. Because of significant differences in the definitions of access modes, it is not reasonable to use mode share data from the survey in this report. Great circle distances from respondents' homes to the origin airports are included in the survey files. Figure 3-2 illustrates the distances traveled by resident air travelers to origin airports summarized according to the nine census divisions of the United States.

Summarizing ground access trips by three distance categories of 0 to 15 mi, 16 to 40 mi, and greater than 40 mi indi-

cates differences in the distributions among the census divisions of the United States. The geographic area up to 15 mi from airports averages from 40 percent to more than 60 percent of all resident access trips. Proportions of fewer than 50 percent of trips in this category tend to be found in airports in the Northeast Corridor, the northern tier of the midwestern states, and along the West Coast. This distribution probably reflects the more highly urbanized development of these regions of the United States. These same areas of the country also tend to have about 30 percent of airport access trips in the range of 16 to 40 mi. Access trips of 16 to 40 mi average from 5 percent to 25 percent of all trips in the other six census divisions. The category of access trips greater than 40 mi accounts for 10 percent to 20 percent of all resident trips across the nine census divisions.

Differences in the geographic distribution of ground access trips are a reflection of the physical development patterns in a region. The number of ground access trips in any one geographical sector is significant for the planning of airport ground access services because different types of access services are more or less suited to different densities of trip origins. The location of the regional highway and transit networks in relation to the distribution of ground access trip origins will have an effect on travelers' ability to reach the closest public trans-

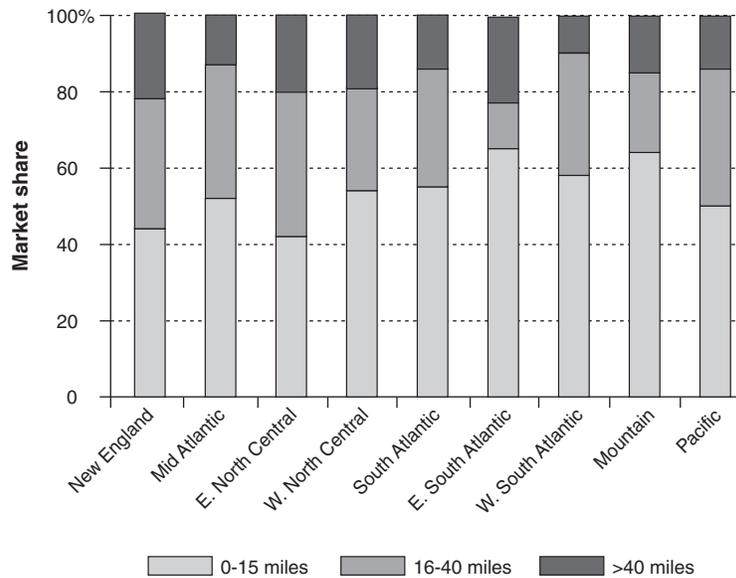


Figure 3-2. Distance traveled from home to origin airport.

SOURCE: 1995 American Travel Survey.

NOTE: *Census Divisions of the United States*

- New England: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut
- Middle Atlantic: New York, New Jersey, Pennsylvania
- East North Central: Ohio, Indiana, Illinois, Michigan, Wisconsin
- West North Central: Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas
- South Atlantic: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, Georgia, Florida
- East South Atlantic: Kentucky, Tennessee, Alabama, Mississippi
- West South Atlantic: Arkansas, Louisiana, Oklahoma, Texas
- Mountain: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada
- Pacific: Washington, Oregon, California, Alaska, Hawaii

portation boarding location. These networks will link individual trip origins to the airport public transportation service, thus concentrating the potential access trip market at selected boarding locations.

Service Requirements and Priorities of Ground Access Travelers

The service requirements and priorities of ground access travelers vary significantly. The descriptions of air travelers and airport employees highlight the basic differences between the two groups regarding airport ground access decisions.

Air Passengers

Air passengers are primarily concerned about dependable travel times, especially as the times relate to flight arrivals and departures. One group of air passengers leaves no margin for time delay in their trip to the airport. Because these air passengers travel to the airport with barely enough time to make their flight departure, they are referred to as “just-in-time” travelers. For most air passengers, missing a flight departure has severe consequences—loss of time, additional cost, and perhaps missing a connection, which leads to additional problems.

Air passengers vary in their sensitivity to ground access costs. Air passengers on business trips are less concerned about access costs than those passengers on nonbusiness trips. For some passengers, such as those on leisure trips with low airfare tickets, the cost of ground access may represent a significant portion of their total travel costs.

Schedule frequency, travel-time reliability, and schedule reliability are important attributes for any airport ground access service. Travel-time reliability is more important to an air passenger than is schedule reliability. However, a passenger may decide to use public transportation even with some unreliability in travel time if these travel time variances are known in advance. Schedule frequency is important to all air passengers.

Airport Employees

Airport employees are concerned about dependable travel time, particularly when they must report to work. The 24-hr operation of an airport makes the service hours of any access service very important, because some airport employees must commute at hours not typically covered in regional transit services. Even if one leg of the airport commute occurs within typical commuting hours, the other leg may be beyond those hours and, therefore, may prevent employees from choosing a public transportation service.

Airport employees are most concerned about the cost of an access mode because as commuters, they must use the service many times a week. Therefore, in order for airport employees to use it on a regular basis, a public transportation service to an airport may need to be priced lower for airport employees. Similar to air passengers, airport employees will be concerned about frequency of service. Infrequent service will be a deterrent to use of a public transportation service by airport employees.

DEFINING THE AIRPORT GROUND ACCESS MARKET

As mentioned in the introduction to this chapter, one objective of market research is to identify target groups for a service or product. One service cannot be the mode of choice for all ground access travelers. The challenge is to identify the key groups that will help the service realize its greatest ridership. Each of the air passenger market segments exhibits certain general patterns of ground access that differ from each other. For each group of air travelers, there tends to be a service or location attribute that dominates their ground access decisions. For airport employees, a combination of work schedule, residence location, and availability of parking determines their access choices.

Air Passenger Market Segments

Resident Business

Resident business travelers generally will be the most frequent users of the airport being studied. Because of its frequent air travel, this segment has developed patterns of access behavior based on repeated trips to the airport. Resident business travelers are likely to know the most efficient means of accessing the airport. In this case, *efficiency* means reliability and other modal characteristics associated with the cost of access. Typically, resident business travelers' air travel trips are comparatively short in duration, and these travelers have very little baggage compared with nonbusiness air passengers. This characteristic makes their travel profile more suitable for public transportation options. However, their sensitivity to access time reliability makes them cautious about using public transportation. Service features such as schedule reliability must be flawless. The just-in-time passenger has a pattern of access that is particularly sensitive to even minor delays. Resident business passengers are more likely to be traveling to and from the airport at peak arrival or departure times. This segment tends to be the dominant user of more convenient (close-by) and expensive airport parking.

Resident Nonbusiness

Resident nonbusiness air passengers are almost certain to be leaving from home, to be traveling in larger travel parties,

to have more baggage, and to have a longer length of stay than are resident business air passengers. Because of the tendency for larger travel parties, they are more sensitive to access costs. They are also more likely to need assistance with baggage handling. Although resident nonbusiness travelers travel less frequently than business travelers, they will have some information available about access to the airport and may have developed a preferred method of getting to the airport, subject to variations in their travel plans. They have a greater tendency to travel during off-peak times and are subject to day-of-the-week variations because of travel promotions by the airlines. Because of the characteristics of their travel, resident nonbusiness air passengers will likely be dropped off or picked up at the airport by friends or family or park in reduced-rate facilities. They are candidates for public transportation access to an airport if the location at which they access the system is convenient and located somewhere between their origin point and the route they would normally take to the airport.

Nonresident Business

Nonresident business travelers are usually either destined for a place of business or a hotel and begin their trips to the airport from the same type of location. These places tend to be located in city centers, near regional attractions, near the airport, or in proximity to regional highways. Depending on the nature of nonresident business travelers' business trips (e.g., a business meeting at one location or multiple meetings with a series of clients), they require the greater flexibility in choice provided by a rental car or taxi. When their destination is the center of the city, they will use the most efficient means of reaching their destination without regard to cost. They are typically users of taxicabs and rental cars. They can be users of public transportation, when the public transportation is expedient and delivers them near their destination without the need for multiple stops and transfers.

Nonresident Nonbusiness

Nonresident nonbusiness travelers are usually the least informed and most unfamiliar with the access options available at any one airport. Although this segment may make multiple nonbusiness trips in a given time period, it is less likely to use the destination airport repeatedly. Air passengers in this segment are most likely to be staying at a hotel or a place of residence. Since they may be unfamiliar with the access options available to them, they will use the most readily available, such as taxicabs or shared-ride, door-to-door vans. When staying with friends or relatives, they may be dropped off or picked up at the airport. This segment of ground access travelers is less likely to use public transportation because of its unfamiliarity with the region. If nonresident business travel-

ers are visiting friends or relatives, they may use public transportation if their hosts have assured them of its reliability and if the access point is conveniently located on their route to the airport.

Airport Employee Market Segments

Airport Employees—Flight Crew

Flight crew employees include pilots and flight attendants who are based in a particular city and travel to the airport to begin their rotation or tour of duty. A tour of duty can last several days. Therefore, their trip from the airport may come a few days after their access trip, and they may not commute more than once a week to the airport. Overall, they constitute a significant proportion of total airport employees but are not a large market for public transportation because of their infrequent commuting. Many flight crew members park their cars at the airport for the duration of their trips.

Airport Employees—Nonflight Crew

Airport employees who are not members of a flight crew will have a work commute of a more regular nature. These employees have varying types of work schedules, some of which change at specified time intervals. Some employees work additional hours on a regular basis or are subject to non-scheduled overtime. If employees have on-airport parking privileges, parking is often free or subsidized; however, the location of the parking may not be convenient to air passenger terminal locations and may require the use of shuttle bus service. These shuttle services may not operate with the same level of service provided to passengers. The more inconvenient airport employee parking is, the more willing employees are to use an alternative that either decreases the amount of time they must wait for connections or increases the ease with which they can reach their reporting locations. As is the case for other commuters, airport employees are more sensitive to the cost of an access service, because they will be using the service multiple times during the week.

One group of nonflight crew airport employees who are strong candidates for public transportation to an airport is airport employees in the many entry-level, low-wage service jobs available at an airport (e.g., working in restaurants or cleaning). Because these jobs can require work commutes at hours not covered by the regional public transportation system and because so many potential candidates do not have access to a private vehicle, airport employers sometimes find it difficult to fill open positions for these jobs. Low-wage employees at an airport would be very sensitive to the cost of an airport access trip; this underscores the need for a pricing system differentiating between air passengers and airport employees.

Geography of the Airport's Local Market Area

As previously mentioned, the most important determinant of an airport's ground access market is the geographic distribution of the air passengers and airport employees who travel to and from the airport. It is also important to know the classification of air travelers by market segment because airports will differ in the proportional distribution of these market segments. There are three ways in which ground access markets can vary among airports:

1. *The physical size of the market.* The geographic size of an airport's ground access market is influenced by factors such as proximity to competing airports, the relative price of airfares at competing airports, the regional transportation networks, and the physical geography of the region the airport is located.
2. *The number of ground access trips originating from different locations.* The distribution of ground access trips within an airport's market area is based on development patterns of the region, population density, and the demographics of the population.
3. *The proportion of air passenger origins attributable to the various market segments.*

Figure 3-3 summarizes the concentration of trips within ground access market areas and market segment differences among airports using San Francisco, San Jose, Metropolitan Oakland, and Boston-Logan International Airports. Each airport exhibits a different air passenger ground access market area. The San Francisco and Oakland airports have similar distributions of passenger origins by distance but differ in the market segments responsible for these trips. Resident origins predominate in the 0- to 15-mi category for Oakland, while nonresident origins predominate in the same category for San Francisco. The Oakland and Boston airports have similar concentrations of nonresidents traveling from 0 to 15 mi away but are opposites in the business versus nonbusiness makeup of these trips. At Boston-Logan, San Francisco, and Oakland Airports, between 50 percent and 60 percent of all access trips originate from a distance of 15 mi or less, whereas at San Jose Airport, more than 80 percent of all origin trips are in this distance category. The concentration of shorter access trips at the San Jose airport is a notable difference from the other three airports. As the closest airport to the many high-technology firms in the Silicon Valley area, the San Jose airport serves a large number of business travelers visiting these establishments, as well as residents who live and work in the area. In contrast, the Boston airport has at least double the proportion of longer distance ground access trips than any other airport. This is a reflection of the Boston airport's dominant position in the New England region up until the mid-1990s. In recent years, airports located to the southwest and north of Boston have experienced an increase in air service and attracted a number of air passengers who formerly used the Boston airport.

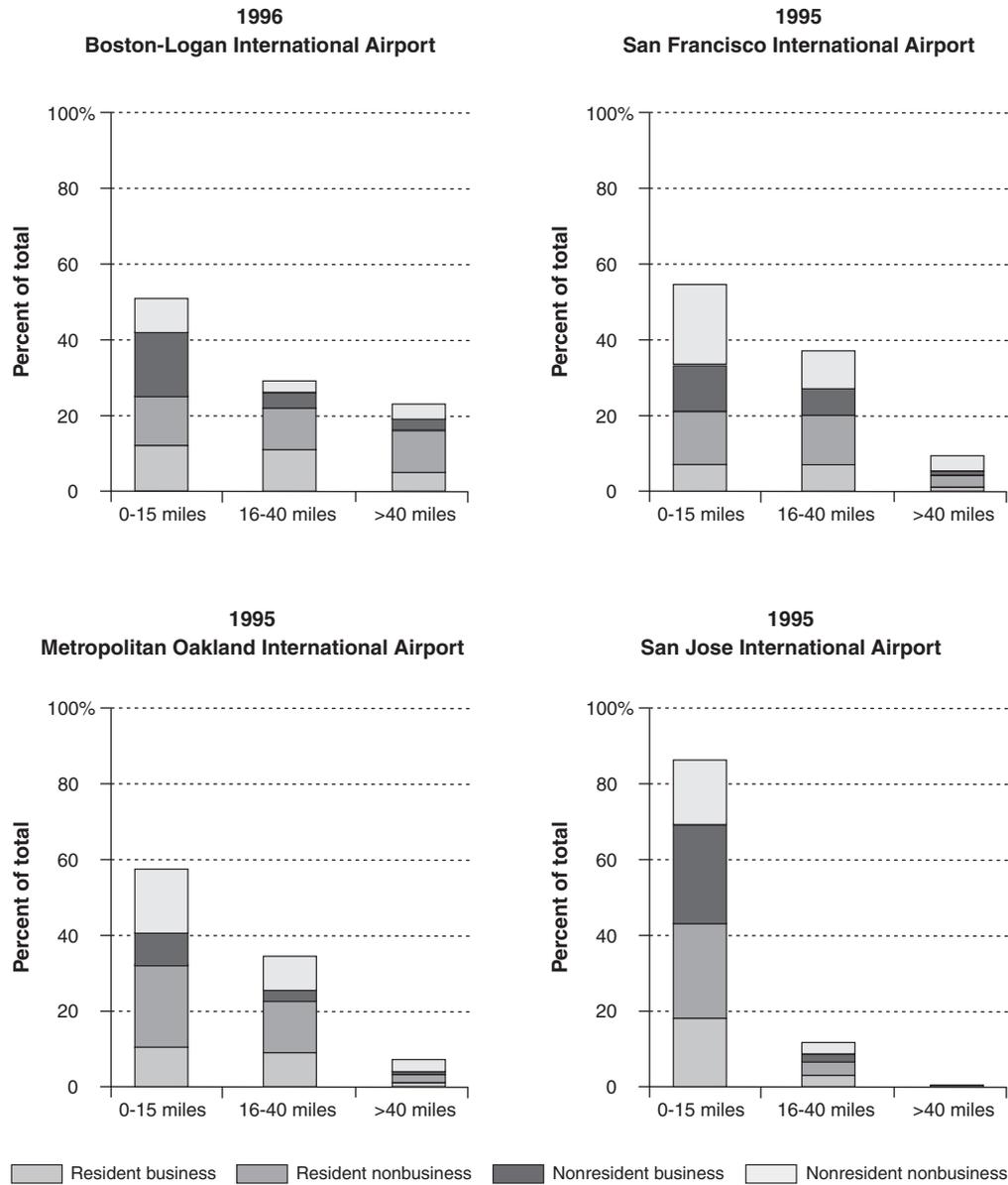


Figure 3-3. Ground access air passenger origins.

SOURCES: 1995 Metropolitan Transportation Commission Airline Passenger Survey; 1996 Logan Air Passenger Survey.

Defining an airport’s ground access market in terms of the four market segments and of the points where the trip to the airport begins or ends helps to explain the differences among airports in the use of various access modes. Two examples of public transportation access to airports illustrate this relationship among mode choice, geography, and markets. The first example is express bus service in Boston, which is successful in serving selected airport markets where the trip to or from the airport begins at points at least 10 to 15 mi away. Important reasons for the success of this access mode are the location of the service’s remote terminals at junctures of the regional highway system (points that airport-bound travelers must pass on their way to the airport) and the number of resident

air passengers who begin their trips from locations beyond the terminal locations. The second example is door-to-door, shared-ride van service in San Francisco. Thirty percent of the San Francisco airport’s air passengers are nonresidents and primarily leisure travelers who begin or end their trip within 15 mi of the airport. As nonresidents, they are not likely to have a private vehicle available, and as nonbusiness travelers, they are concerned about access cost. Many of these air passengers begin or end their trips to a hotel or residence in San Francisco. Door-to-door shared-ride van service to and from the airport is a logical choice because it provides the door-to-door service of taxicabs—a mode typically used for shorter distance trips—at a lower cost than taxicabs.

AIRPORT GROUND ACCESS MARKET RESEARCH

The successful implementation of market research in an airport environment and the study of ground access travel are dependent on the clear articulation of the uniqueness of air travel and of the activities related to it. The following is a general review of market research methodology. The review is designed to provide the reader with an understanding of the steps involved in market research studies as they are applied to airport ground access.

There are two basic types of data: primary and secondary. A primary data source is, as the name implies, information collected directly from the customer—in this case, the ground access traveler. Primary data are information obtained directly from the individuals who comprise the potential population of service or product users. Secondary data are information obtained from sources originally collected for other purposes.

The discussion about ground access market research will focus on the collection of primary data by means of airport-based surveys. Airport-based surveys provide the best source of information about ground access patterns and the choices of air travelers and airport employees who travel to the airport. The general procedural steps in conducting either a passenger or employee survey are similar; however, the procedural steps are implemented in different ways.

Defining the Problem Statement

The problem statement defines the purpose of the market research effort. It is important that this statement be clear and unambiguous because the research that follows is designed to collect the data needed to answer the question posed in the problem statement. An example of a statement for ground access research is “What is the geographical distribution of this airport’s ground access market and the current modes of access used by the various market segments?” This statement describes the basic information needed to begin a study of alternative modes of access.

When considering an airport survey, it is important to develop a clear statement of the research problem among all interested parties. Discussions with various airport ground transportation staff members, airport planning staff, other airports, and airline representatives who regularly deal with ground access travelers can help clarify potential research obstacles before they are encountered. These discussions can solidify the objectives of the research and identify important knowledge that airport staff may have about the ground access traveler.

Developing a Market Research Study

There are five general steps to follow in developing a market research study:

1. Deciding what information to collect,
2. Selecting a data collection method,
3. Determining the sampling frame and sampling method,
4. Developing the questionnaire, and
5. Summarizing and analyzing the results.

In planning a market research study, airports generally solicit the help of consultants because of the level of effort required to conduct a survey. Before a proposal for a consultant is prepared, these five steps should be reviewed to ensure that the consultant is given the instructions needed to conduct a successful research effort.

Step 1: Deciding What Information To Collect

At this early stage of the research study, it is important to involve as many of the people and departments that will make use of the collected information as is possible. It is also important to collect sufficient information to use in defining the market segments for a public transportation service but to not request such an overwhelming amount of information that the survey proves to be burdensome to the respondents. The following information is needed from air passengers for ground access planning:

- Residence location;
- Trip purpose;
- Destination airport;
- Mode of transportation to the airport, including
 - Private vehicle (drop-off, drop-off and parked, parked for duration on-airport, or parked for duration off-airport),
 - Rental car,
 - Courtesy vehicle,
 - Taxicab,
 - On-demand limousines,
 - Prearranged limousines,
 - Chartered bus or van,
 - Shared-ride door-to-door van
 - Bus (express and multistop), and
 - Rail service;
- Origin of access trip to the airport;
- Type of origin from which the traveler departed;
- Travel-party size;
- Number of people who came into the terminal to see the traveler off;
- Arrival time inside the terminal prior to flight departure time;
- Departure time from local origin location;
- Number of pieces of luggage (checked and/or carry-on) taken on flight;
- Length of the air-travel trip (nights away from home);
- Number of times the traveler has flown out of this airport in the year preceding the survey;
- Traveler’s household income before taxes in the year preceding the survey;

- Traveler's gender;
- Traveler's age;
- Number of people in the traveler's household;
- Traveler's highest level of education; and
- Airline, flight number, and departure time and date.

For purposes of understanding the airport employee market, the following basic information should be collected.

- Residence location;
- Mode of transportation to the airport, including
 - Private vehicle (drop-off, parked near work site, parked on-airport and shuttle bus, or parked off-airport and shuttle bus),
 - Car or van pool,
 - Taxicab,
 - Bus (express or multistop),
 - Rail service, and
 - Other (walking or bicycling);
- Amount of time spent commuting;
- Airport work location;
- Work schedule (daily or weekly);
- Employer;
- Employee's household income before taxes in the year preceding the survey;
- Employee's gender;
- Employee's age;
- Number of people in the employee's household;
- Whether employer provides free or subsidized parking and the location of parking; and
- Requirement for overtime work.

Airport ground access market research is primarily concerned with the access mode choice of air passengers and alternative access modes. To date, far less attention has been given to questions about egress mode choice. There are at least three reasons why airport market research has paid less attention to the egress mode choice of air passengers:

1. Air passengers are primarily concerned with reaching the airport in time for their flights. There is less concern with time when departing from the airport.
2. It is difficult to get accurate answers to a question about egress mode from air passengers when surveying passengers prior to their air trips—a time when many airport surveys are conducted. The choice of egress mode involves a number of factors, and many air passengers do not make a decision until they return to the origin airport. Therefore, responses given prior to passengers' air trips do not necessarily represent actual choices. Nonresidents could be asked this question because they have already made egress trips from the airport upon their earlier arrival; however, nonresidents would represent only one portion of air passengers.

3. Even if it were realistic to ask air passengers about their egress modes, it would be confusing for a survey participant to be asked the ancillary information needed to understand an egress mode choice in the same survey addressing access mode. A separate survey would need to be conducted, which would be costly.

To answer the question of egress mode choice accurately, a separate surveying effort is needed. An airport may consider this effort necessary if other information about ground transportation modes indicate an imbalance in inbound versus outbound passenger flows. Various types of passenger counts can be used to verify this imbalance, including modal data collected by the airport or passenger counts from the various ground transportation operators serving the airport.

Step 2: Selecting a Data Collection Method

There are a variety of methods for collecting primary data including mail surveys, personal interviews, telephone surveys, self-administered surveys, panels, focus groups, interactive research, and observation (22). Each method is useful in particular situations, and all have advantages and disadvantages. This discussion will concentrate on focus groups and surveys—two methods useful in ground access market research.

Whether it is a personal interview, telephone survey, self-administered, or mail survey that is being conducted, all require the use of prepared questionnaires. Focus groups do not require questionnaires, but they do require preparation and input from the airport staff to the consultant conducting the focus interviews. Focus groups are used when there is a need for in-depth research into a particular topic and are also a valuable tool in developing the questions that will be used in surveys distributed to a wider audience. Each of the two methods—focus groups and surveys—will be discussed in detail in the following sections.

Focus groups, as a method of market research, are singled out because they provide an excellent way to investigate customer responses to a subject in depth. They can be helpful in deciding which topics to study, what attributes are important, and other specifications needed for questionnaire development. Focus groups do not necessarily represent the actions or opinions of all ground access travelers, but they do provide a way to understand the concerns or reactions of a portion of ground access travelers. A focus group is usually a small group of no more than 12 people who are interested in a topic and who, with the guidance of a facilitator, discuss the topic for a period of 1 to 2 hr. With a skilled facilitator, a focus group can provide valuable information and ideas about the selected topic—information and ideas that are more insightful than any that could be obtained through a prepared survey. Group dynamics also comes into play, whereby comments by one participant initiate dialogue from others.

A focus group is a relatively inexpensive way to explore the dimensions of ground access concerns to air passengers. A series of focus groups could be set up to represent both the geographic distribution of air passengers as well as the market segments. The topic of discussion is established by the contracting agency, and it is the facilitator's responsibility to draw out various points of view among the participants.

Surveys are one of the most widely used forms of market research. Because they present respondents with a set of multiple choice questions, surveys provide a means of standardizing the answers received from customers and allow analysis by means of various compilations. They can be administered in a number of ways, including mail, telephone, personal interview, and on-site self-completion. Surveys can provide a wealth of information concerning the respondents and their service choices for ground access. Most airports that have conducted market research have used some type of survey methodology. It is most efficient to contact air travelers at the airport because it is in this one location that all air travelers using ground access have congregated. The only filtering needed is to exclude air travelers transferring between flights who have not left the confines of the airport proper.

Methods for conducting an air passenger survey can vary by airport, but the necessary information to be collected for ground access are the same. Two survey techniques, each having advantages and disadvantages, are personal interviews and self-completion questionnaires. A personal interview ensures a more thorough completion of questions with the added advantage of enabling the interviewer to query the respondent when answers are ambiguous. The drawbacks of personal interviews are the limited number of surveys that can be completed in a given time frame and the potential for either under-sampling travelers who are more time conscious or over-sampling travelers who arrive far ahead of scheduled departures (primarily nonbusiness passengers). Personal interviews may be a reasonable option when the survey to be administered is complex. The other approach, self-completion surveys, requires the distribution and collection of questionnaires at designated airport locations such as security checkpoints and aircraft boarding lounges. The advantage of this method is that many surveys can be distributed and completed in a limited amount of time. The drawbacks of self-completion surveys include limited returns from just-in-time air passengers, the inability of the respondent to ask questions about how to properly complete the survey, and the extra effort needed to ensure adequate sample sizes.

The techniques for collecting ground access information from airport employees are either to distribute self-completion questionnaires at the airport work site or to mail the forms to home residences. The difficulty in conducting an airport employee survey is the need for a list of all airport employees. The development of this list will be discussed under the topic of sampling frame in the next section.

Step 3: Determining the Sampling Frame and Sampling Method

The Sampling Frame. Obviously, it is not feasible to contact every ground access traveler and ask him or her questions about his or her access trip. In sampling, a small group of ground access travelers are selected to provide information that is considered representative of the entire population of travelers using an airport. The actual implementation of sampling and the selection of a sample should be done by consultants familiar with statistics and probability. Explanation of some basic sampling concepts related to airports and ground access will help those people involved in survey planning. First, two terms need to be defined. The *universe* is the total population (i.e., all ground access travelers). The *sampling frame* is a list representing the universe from which a sample is selected. Because it is impossible to have a perfect list, a good research study team will understand the shortcomings of the sampling frame so that it can make allowances in the design of the study. The principal concern in conducting airport market research is the development of the sampling frame. To ensure that results of a survey can be generalized to the entire population of ground access travelers, care should be taken to construct a list that is representative of all air passengers and airport employees. The following example illustrates what is involved in the development of an air passenger sampling frame:

Example of an Air Passenger Sampling Frame

The sampling frame for the 1996 Logan Airport Air Passenger Survey was composed of all scheduled airline seats available over a 2-week period.

A few weeks prior to the survey period, the Official Airline Guide (OAG) was consulted and a spreadsheet of all departing flights for the survey period developed. The information in the spreadsheet included the airline and flight number, scheduled departure time, days of operation, aircraft type, seating capacity, great circle distance, and flight itinerary. Each flight was assigned a distance code representing the flight distance/itinerary. The number of flights to sample was determined from the following information: historical survey sizes and the Massachusetts Port Authority's desire for detailed analysis, the average flight's seating capacity, past load factors, and response rates. All flights listed in the OAG for the 2-week survey period were sorted first by day, then by distance code, then by departure time. Finally, a cumulative total of the seating capacity was assigned to each flight (23).

In developing an airport employee sampling frame, more than one source of information may need to be consulted. The airport administration should have a list of companies leas-

ing space from the airport. Although this list may provide the names and administrative addresses only of the employers, the employers can be contacted and asked to provide more detailed information. This could include information about their different facilities and locations on the airport, the number of employees reporting to each location, and the number of airport-based flight crew employees. Finally, security access methods used by the airport and air quality ridesharing/trip reduction reports required in certain cities may provide other potential sources of information about airport employees.

Probability versus Nonprobability Sampling. The heart of sampling is the difference between probability and nonprobability sampling. Probability sampling, also referred to as random sampling, means each sampling unit has an equal, known chance of coming into the sample (24). In probability sampling, a random sample allows the calculation of the accuracy of the results; nonprobability sampling does not. Probability sampling should be used for determining the access choices of air travelers and airport employees because it provides a known degree of accuracy. The degree of accuracy required and the survey sample size is related to (1) the size of the geographic zones that will be used in analyzing the airport ground access market area and (2) the cost of the survey.

A straight probability sample is almost impossible to achieve because it requires an almost perfect sampling frame (i.e., a list of all ground access travelers), which typically is not available. Other types of probability sampling are easier to implement because they take into consideration the non-random way in which a list of ground access travelers is usually developed.

Step 4: Developing the Questionnaire

The survey questions are critical to the success of the research effort. For ground access purposes, the questions should, at a minimum, relate to the list of information needs noted previously in Step 1: Deciding What Information To Collect. Although there are similarities in the information required of air passengers and employees, there is also information unique to both groups that should be collected. Additional questions can be tailored to the specific airport environment under investigation. In cases of multiple airport markets being investigated, questions should be included to determine the relative use of one airport versus another. In lengthening the survey, caution is advised because the length of time required has implications for survey completion. The longer and more complicated the survey, the less likely a passenger is to complete and return it.

All aspects of a survey questionnaire are important to a successful market research study because it is crucial that information required to answer the problem statement be obtained. Production of a good questionnaire is an art—the manner in

which questions are phrased, the order of questioning, the grammar, the length of the form, and the type of information that is requested all have implications for the successful completion of the survey. The wording of each question should be as simple and direct as possible and should be neutral in tone. Finally, the questionnaire should be tested on a small group of individuals from the sampling frame.

Survey respondents may be sensitive to requests for certain personal information. For example, people are often reluctant to report information such as income and age, and when they do respond, the information may be inaccurate. However, this type of information is needed for classification and segmentation purposes among certain consumer groups and is worth including in the questionnaire. It is advisable to have requests for this type of information located near or at the end of the questionnaire, so that if the personal questions are skipped, it is more likely that the rest of the questionnaire will be completed.

Example of an Air Passenger Survey Outline

- A. Greeting and introduction to survey
- B. Instructions for completing questionnaire
- C. Questions concerning the ground access trip to the airport
 1. Mode of access
 2. Detailed questions about particular modes
 3. Questions about the origin of the ground access trip (type of location, departure time, arrival times at airport, and so forth)
 4. Questions about alternative modes and ground access services.
- D. Questions about the air travel trip
 1. Final destination
 2. Purpose of air travel
 3. Questions to determine resident versus non-resident status of passenger
 4. Questions to determine the length of the trip (days, or nights away from home)
 5. Questions about the travel party
 6. Frequency of air travel to subject airport
- E. Classification questions
 1. Home address
 2. Demographic information
 3. Airline, flight number, and departure time

Step 5: Summarizing and Analyzing the Results

In preparing the research plan, it is important to consider and document how the collected information will be used and by whom. Remember that data can always be summarized, but information collected and stored in a summarized

fashion cannot be broken down into its component parts. Therefore, it is advisable (1) to collect and store data in the most discrete manner needed for any required analysis and (2) to use one of many available statistical software programs to aggregate the information for purposes of summary tables or discussions.

Once the data have been stored in database format, they can be processed and analyzed using any of a number of software packages. These packages usually have different modules for specialized, as well as general, analysis. Because of the extent of currently available computing power, it is fairly straightforward for an analyst to complete any of a variety of procedures. One does not need to be a statistical expert to complete many types of analysis; it is more important to be familiar with the subject population. Because of the ease with which complicated analysis can be completed, it is more important to understand whether the end results that are derived make sense based upon general knowledge about the subject.

MARKET SEGMENTATION

Segmentation is a means of classification used in market research to organize and summarize groups of individuals who have similar responses to a product or service. Market segmentation is an important concept because it directs marketing efforts toward those groups of individuals who are more likely than other groups to use a product or service, rather than trying to respond to the needs or desires of an entire population (25). This concept is likewise important to the study of airport ground access because segmenting the airport ground

access market helps to identify the groups of airport travelers who are the most likely to use public transportation. To segment airport travelers for the ground access market requires two types of information: (1) the identification of the specific ground access travel needs that can be met by the public transportation service under consideration and (2) the geographical concentration of ground access travelers who have the characteristics typically associated with these needs.

Variation in Market Segments

Ground access market segments are not static—they are a reflection of the market for air travel at an airport, a market that is continually changing. Air travel is affected by a number of events such as the status of regional or national economies and changes in airline service. Figure 3-4 presents the market segments at Boston-Logan Airport as measured by four different air passenger surveys conducted from 1987 to 1996. The greatest fluctuations in the market are in the proportion of resident nonbusiness and nonresident business segments. The early 1990s was a period of lagging air passenger activity in Boston due to a decline in the New England regional economy. This had an effect on resident air travel and, most notably, on nonbusiness travel. The economy improved by the mid-1990s with a return of nonbusiness travel by residents.

Pre-Survey versus Post-Survey Segmentation

In previous sections, four air traveler market segments and two airport employee segments were used in describing the

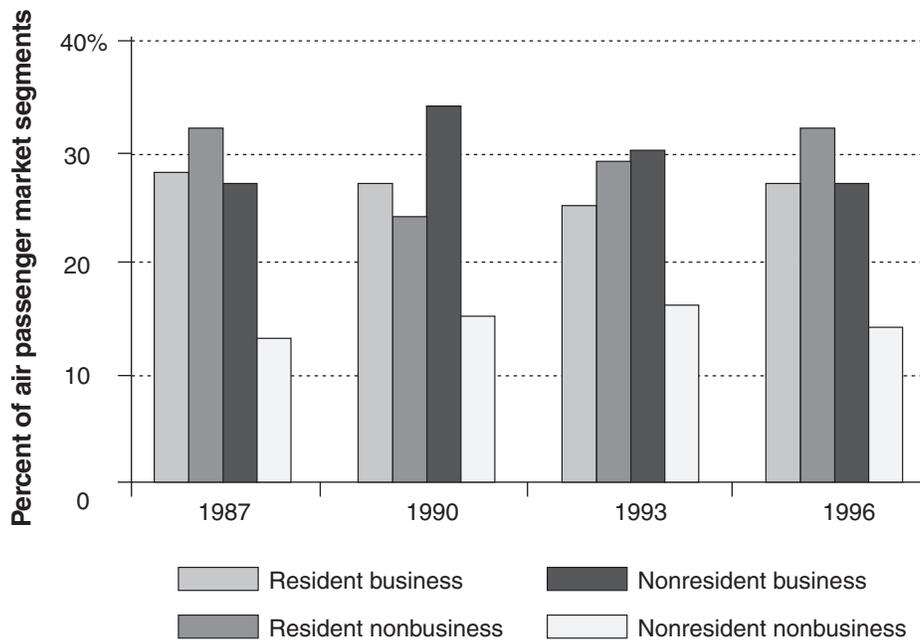


Figure 3-4. Boston-Logan International Airport.
SOURCE: 1987, 1990, 1993, and 1996 Logan Air Passenger Surveys.

airport ground access market. These market segments have proven useful and appropriate in planning new public transportation services to airports; however, there may be other significant factors in localized airport markets throughout the United States. If the correct information is collected in the airport market research survey, a post-survey segmentation analysis will identify the appropriate market segments. This is one of the reasons it is important to include a wide representation of airport personnel (e.g., those personnel dealing with ground access services, airport planning, and air passenger services) in the early stages of planning for any airport survey. These personnel can provide the needed insight into the air passenger and employee information that is important to collect.

Market segmentation is, by definition, an acknowledgment that one service cannot be all things to all people. The key to any successful service marketing is the pairing of what the service can offer with the market segments that will respond to the particular service's attributes. The airport market for public transportation is not the typical commuter market. The characteristics of air travel and of the particular individuals who are traveling by air must be approached from the rationale of service substitution (i.e., Does the proposed public transportation service provide important selected attributes of the ground access travelers' preferred mode choice?). For example, many resident business travelers prefer to park their private vehicles for the duration of their air travels. If this market segment is a key target for a new public transportation service, then parking must be available at the boarding location.

Needs-Based Segmentation

There are many ways to segment a population of customers; however, one useful tool to consider for ground access research is called "benefit" or "needs-based" segmentation (26). Needs-based segmentation, as applied to airport ground access, is

based on the idea that the benefits travelers are seeking in a ground access service are the basic reasons for market segments. The information obtained from this kind of research is particularly useful in the design of a ground access service and in the way the service is promoted to the public. *TCRP Report 36*, "A Handbook: Using Market Segmentation to Increase Transit Ridership," describes in detail how to conduct such a study.

One reason for using needs-based segmentation is the way in which the market segments are derived. Based on causal factors (e.g., availability of parking or travel time reliability) rather than descriptive factors, the resulting market segments reflect user categories that are directly linked to the attributes of the ground access service under consideration. The principal drawback to this method of segmentation is the cost and effort required to develop and implement the survey needed to collect the market information. When correctly executed, needs-based segmentation is one of the best ways to segment markets (27).

Although needs-based segmentation produces the best results, it is not a simple research study to complete. In lieu of using this type of segmentation, a model relying on market segments based on residence and trip purpose can be used. These market segments will not explain access mode choice, but they will provide a basis for organizing ground access travelers according to widely accepted descriptors.

Use of Market Research Information

Air passenger and employee survey data provide valuable information about potential customers for ground access services. Once the survey data processing is completed and responses have been scaled to represent all airport ground access travelers, many uses can be made of this information. Table 3-2 provides examples of different types of survey data and of how the data can be used in planning an airport public transportation access service.

TABLE 3-2 Uses of airport ground access survey information

Air Passenger and Airport Employee Survey Data	Uses in Planning Public Transportation Service to Airports
Distribution of air passenger and employee arrival and departure times	Developing public transportation service schedule
Air passenger trip purpose and home residence location (market segments)	Identifying the potential for alternative public transportation services
Geographic location of air passenger and employee origins	Locating public transportation boarding sites (station, terminal, stop)
Distance and concentration of air passenger and employee origins from the airport	Identifying suitable types of transportation access services
Air passenger evaluations of public transportation service attributes	Designing public transportation service features

SOURCE: MarketSense.

The following hypothetical example illustrates how survey data are used in planning a public transportation access service to an airport. Assume that the target market for a new access service is the resident business traveler. This segment has been chosen because it represents the largest number of ground access trips from a single geographic corridor within the overall region served by the airport. In analyzing survey data specific to this group of travelers, it is found that the majority of access trips to the airport are made in the early morning, the present access mode is usually a private vehicle parked at the airport for the duration of the trip, and the air travel trips last for a period of 1 to 3 days. To ensure the new airport public transportation service is attractive to the resident business traveler market segment, the airport access service would require direct, nonstop service in the early morning hours, with the first public transportation trip arriving at the airport no less than 30 min before the first scheduled flight departure. This service guarantees that an air traveler could be on the first flight departure of the day. During the rest of the day, the public transportation service would not need to be nonstop from the location serving the targeted business traveler. The boarding location would need to have sufficient parking spaces available for all resident business passengers to park for a period of up to 3 days.

A MARKET RESEARCH APPLICATION— BOSTON-LOGAN INTERNATIONAL AIRPORT'S GROUND ACCESS PROGRAM

Introduction

Since 1979, the Massachusetts Port Authority (Massport) has been involved in airport market research related to air passengers and airport employees. It has commissioned air passenger surveys, employee surveys, air passenger focus groups, behavioral research, and individual modal surveys. All of these efforts have contributed to the Massport's understanding of air passenger and employee ground access patterns and have served as the foundation for successful initiatives to address the airport's ground access problem.

The first air passenger survey was conducted in 1979 with subsequent surveys in 1984, 1987, 1990, 1993, 1996, and 1999. Market segments useful for ground access planning were developed based on the results of the 1979 survey. In 1984, Massport also commissioned a series of focus groups to help it understand the important ground access issues for various groups of air travelers. The information derived from these early focus group sessions proved to be remarkably insightful. Realizing the need for information about airport employees, Massport conducted an employee survey concurrent with the 1979 air passenger survey. This employee survey was followed by other employee surveys in 1984 and 1990. The information obtained from the focus groups and air passenger surveys was used in the design of and subsequent service changes to the Logan Express bus services to the airport. Mass-

port conducted annual surveys of Logan Express passengers in the first few years following the inception of the services in 1986. These surveys were used to monitor customer satisfaction with the services and to obtain information about the type of passengers using the services. The following discussion will trace the evolution of Massport's market research program, emphasizing the application of market research findings to ground access service improvements.

Historical Context

Some historical background about Boston-Logan Airport is needed to understand the context in which the market research program was developed and why the program continues to play an important role in ground access planning. Ground access became an issue in the early 1980s. A few years following the deregulation of the airlines in 1978, air traffic at Boston-Logan increased dramatically, and the airport's ground access problems emerged. Air passengers for calendar year 1980 totaled 14,722,363. By the end of 1985, total air passengers had reached 20,452,161, a 39 percent increase in 5 years. (Other airports experienced similar increases; however, the particular characteristics of Boston's airport made these passenger increases have a significant effect on airport access.)

There were three major reasons for the ground access problems facing Boston-Logan: (1) the airport's geographical location, less than 3 mi from downtown Boston meant that most of the traffic destined for the airport had to mix with regional traffic flows destined for Boston; (2) the high proportion of air travelers who originate or are destined for the region (approximately 90 percent of all air passengers at Boston-Logan begin or end their trip locally) and (3) limited access to the airport via two tunnels and a bridge (there is now an additional means of access via the new Ted Williams Tunnel, but at the time when the airport was experiencing tremendous growth, the tunnel was only in the planning stages).

The increases in air traffic of the early 1980s had noticeable effects on the roadways leading to and from the airport and at terminal curbs because most air passengers reached the airport via private vehicles. According to the 1979 Logan passenger survey, the mode share for private vehicles was 54 percent. By the time of the April 1984 air passenger survey, the private vehicle mode share was virtually the same at 55 percent; however, there were changes in the way the mode was utilized. The proportion of pick-up/drop-off was 31.9 percent in 1984 compared with 33.6 percent in 1979; 23 percent of all passengers parked long term for the duration of their trips in 1984 compared with a long-term park mode share of 20 percent in 1979. These changes in the long-term park mode share underscored the noticeable increase in the demand for parking at the airport. At certain peak times of the year, the on-airport parking filled up and air passengers had to park at Suffolk Downs, a racetrack located to the north of the airport, and be transported by shuttle bus to the airport (28).

Any further increases in demand for long-term parking at the airport had the potential for creating significant problems because the Environmental Protection Agency (EPA) had imposed a parking freeze of 10,215 spaces at Boston-Logan. The only way Massport could construct new parking was first to seek revisions in the parking freeze. In late 1983, plans for constructing additional parking and for revising the parking freeze were under way; however, key administrative officials at Massport realized that a much broader solution to future ground access problems needed to be implemented. Even if the parking problem could be solved, there was still the problem of getting private vehicles to the airport using already congested roadways. Plans for new parking were put on hold, and a much broader review of Boston-Logan Airport access and potential solutions became the focus of the Massport.

Air Passenger Focus Groups

In 1984, Massport's market-based approach to ground access began to unfold. A series of focus groups were convened so that Massport could understand the concerns of the traveling public. The air passenger focus groups were composed of travelers who had made three or more business trips from Boston-Logan Airport during the past year. Groups were composed of business air passengers representing two principal geographic markets of the airport to the northwest and south of Boston as well as travelers not living in the immediate region. Both men and women were included in the sample but participated in groups separated by gender (29).

The problem statement as defined by the consultants conducting the focus groups was "to better understand how air travelers make their decisions about ground transportation." One of the objectives of the research was to determine the factors important in selecting a ground access mode. Participants mentioned convenience as the most important factor in determining their use of a private vehicle to access the airport. Results indicated that perceptions of distance between the airport and origins affected air passengers' selection of access mode. Those passengers who perceived the airport to be nearby were most likely to drive or take a taxicab. Access cost was a factor considered important to nonbusiness air passengers but was not an important consideration for business air passengers. The focus group discussions indicated that air passengers must perceive a tangible personal benefit in selecting an alternative to their preferred mode of access (30).

Concurrent with the focus group interviews, Massport undertook a public awareness campaign about the ground access issues at the airport and began looking for alternatives that would be appealing to air passengers using private vehicles to reach the airport. Based on geographic information from the air passenger surveys and modeling efforts, the concept of a remote parking lot with express bus service to the airport was developed.

A Test of the Express Bus Service Concept

Before the development of a remote parking site could proceed, the busy Thanksgiving 1985 holiday travel period was approaching. Because of concern over insufficient parking at the airport during the traditional heavy business travel period the week before Thanksgiving, Massport's administration decided to provide a one-time service for 2 weeks before and during the Thanksgiving holiday. Express bus service to the airport would be provided from the parking garages of two rail rapid transit stations to the west and south of Boston. Air passengers could park their cars at the transit station parking garages and then board an express bus to the airport.

It was uncertain how many people would make use of this service; however, it was an opportunity for Massport to test the concept, to provide some relief to the heavy demand for parking expected at the airport the week before Thanksgiving, and to collect information about the types of travelers that would use an alternative access mode to reach the airport. The service was provided free of charge, and during its 2 weeks of operation the service carried 7,636 passengers. Approximately 1,850 questionnaires were distributed to both inbound and outbound passengers, and a response rate of 84 percent was achieved. The questionnaire asked what mode passengers would have used if the bus service was not available, what the purpose of their air travel was, if they would use an express bus service again, what improvements were needed for this type of service, how frequently they traveled, where they lived, and what fare they would be willing to pay for the service. Survey comments about the bus services were extremely positive. The mode of access for the majority of the respondents would have been private vehicle, and the profile of the travelers was similar to known travel patterns the week before and during the Thanksgiving holiday. The week before Thanksgiving, the majority of air passengers (62 percent) were on business trips; the week of Thanksgiving, the majority of air passengers (76 percent) were on nonbusiness trips. The results of the experimental service were promising. Even the responses to the fare question were encouraging. Typically, it is difficult to obtain reasonable answers to direct questions about people's willingness to pay for a product or service; yet, almost 70 percent of the survey respondents said they were willing to pay at least \$2.00 for each one-way trip.

Commencement of Logan Express Service

A number of remote locations were tested for ridership potential and two were selected for implementation. One location was the parking lot of a large regional shopping center located about 23 mi west of the airport in Framingham, Massachusetts. The other location was the same used during the free Thanksgiving service, the Quincy Adams rail rapid transit station, about 10 mi south of the airport. Service was started in September 1986 from Quincy Adams and in November 1986 from Framingham.

Behavioral Research—The Logan Air Traveler Market for HOV Services

While plans for the Logan Express services were progressing, Massport commissioned market research in order to understand further the market for public transportation among air travelers. In June 1986, another survey of departing air passengers was conducted. This time the survey questionnaire was designed to obtain information that would help Massport understand how air passengers value various aspects of ground transportation services. (This information was to be used in the operation of the new Logan Express services.) A 2-day survey was conducted on June 24 and 27, 1986, with a total of 5,800 self-completion questionnaires distributed in airline waiting areas. A total of 1,901 usable surveys were returned.

In addition to questions about geographic origins, access modes, socioeconomic information, and travel characteristics needed for classifying air passengers, three new types of questions were included to find out how air passengers value particular design features of public ground transportation to the airport. The three types of evaluation questions asked air passengers (1) to rank, from a large number of choices, the five most important service characteristics of a public ground access mode; (2) to rate the importance of three levels of service for highway access to the airport; and (3) to rank their choices for four new public ground transportation services, each of which was described by a selected group of service characteristics.

The questions were designed to provide information on how air passengers rank public transportation service amenities and how they rank service aspects of private vehicles. There were three different versions of the survey questionnaire. In one version of the questionnaire, the ranking question appeared as it does in Figure 3-5.

Important findings were compiled for each of the four market segments. An analysis of the ranking questions showed that the characteristic “always on time” was ranked in both first and second place most often by the different market segments. “Travel time equal” and “easy access” also ranked quite high in air passengers’ evaluations of the characteristics (31). Massport took the high value placed on the attributes of “always on time” very seriously. The Massport bus contractors were required to have buses leaving exactly at the departure time listed on the schedule. This particular feature proved to be important for travelers even if the travel time to and from the airport varied. Travelers would set aside additional time for their access trips during peak highway travel times.

In addition to asking about HOV modes, the survey asked passengers to rate the importance of three characteristics of private vehicle trips to the airport: (1) the importance of heavy traffic on the way to the airport, (2) the possibility of no available parking at the airport, and (3) the possibility of heavy traffic congestion on the return trip leaving the airport via the

8. For your trip to Logan today, imagine that a new transportation service was available from a convenient boarding point near your route to the airport. In questions 8 and 9 we want you to help us decide what features would make people like you most likely to use such a service.
- From the list below, please choose the FIVE features that are the most important to you. Put a A1” beside the feature that is the most important, a A2” beside the second most important feature, and so on until you have put a A5” beside the fifth most important feature.
- Rank the five most important features:
- The service operates at least every 30 minutes
 - The service operates at least every 15 minutes
 - The service runs from 5:00 a.m. to 12:00 midnight
 - The service is always on time
 - The boarding point is well lit at night
 - The boarding point has a uniformed security guard
 - The boarding point has a manned information booth
 - The boarding point has a coffee shop
 - The boarding point is easy to get to
 - A seat is guaranteed for the trip
 - The travel time from the boarding point to the airport is the same as or less than the travel time by car
 - The service could be paid for by credit card
 - The cost of the service including parking at the Boarding point is less than the cost of parking at Logan

Figure 3-5. Sample question from 1986 Boston-Logan International Airport Ground Access Survey.

SOURCE: 1986 Logan Airport Ground Access Study survey form.

tunnel. From the ranking of these attributes, it was found that heavy congestion on the way to the airport is much more important in determining how one will access the airport than heavy congestion on the return trip (32).

Logan Express Market Research

The first surveys of Logan Express passengers were conducted in January and June 1987 and continued throughout the operational history of the services. The surveys were used to measure changes in the composition of the market as ridership increased and the services matured. The surveys were also used to question passengers about potential service changes and to measure their satisfaction with service quality. The surveys provided a means of keeping in touch with Logan Express customers and of furthering understanding about air passengers’ access mode choices.

From 1986 to 1990, the Framingham service carried almost twice as many passengers as the Quincy Adams service. This fact was puzzling, in light of the comparison of the market information from the Logan Express surveys with the information from the Logan air passenger surveys. Each express bus market area was delineated based on reported passenger origins from Logan Express surveys. The number of average daily air passengers in each express bus market area was totaled based on data from the 1987 Logan Airport Air Passenger Survey. The two market areas were comparable in the number of daily air passenger trips to the airport. Why were

two similar market areas served by the same type of service not attaining the same or even nearly the same mode share? The answer to the ridership differences between the two services could not be found in surveys of current Logan Express passengers.

Logan Express Service Modifications and Relocation

The number of resident air passengers—the target segment for the Logan Express service was comparable in both the Quincy Adams and Framingham market areas. Yet, the Framingham service had considerably higher ridership. Air passenger market research made Massport aware of this incongruity and indicated that some other factor was limiting patronage of the Quincy Adams service. Furthermore, based on market research of Logan Express passengers, Massport knew that parking and other service features were in need of improvement. Therefore, Massport searched for a new location for the Quincy Adams Logan Express service that did not have some of the impediments to passenger growth experienced at the Quincy Adams rail rapid transit station. These impediments to passenger growth were not because the service was located at a rail rapid transit station, but because available parking was limited since the transit station's garage filled up early in the morning. In addition, the station was not visible from the highway and there was no dedicated waiting area for travelers who wished to use the Logan Express service.

Of the sites available for relocating the service, the relative attractiveness of each site to existing passengers was affirmed through a survey that asked passengers to rank their choices for alternative sites and their willingness to use a new location. The service was relocated to a stand-alone facility with ample dedicated parking, excellent highway access, and good visibility, at a distance of less than 2 mi from the current site. Within a relatively short time after relocation, the ridership on the Quincy Adams service, now designated as Braintree, started to increase.

Ridership surveys were conducted about 1 year after the relocation and included specific questions to determine the characteristics of the new riders and why the riders had not used the service previously. Table 3-3 shows the proportional distribution of responses to the question "If you did not use the Quincy Adams Logan Express service, why are you now using the Braintree service?" Respondents were allowed to check off multiple reasons. Of those travelers using the new service, 45 percent responded either that they didn't know about the Quincy Adams service or that the new location was more convenient. These responses underscore the importance of both geographic location and the difficulty of marketing a new service. Massport spent considerable funds on advertising in a variety of media including print and radio. In replying to the question "How did you first hear about the service?," which

TABLE 3-3 Responses to Logan Express survey questions

Reason For Using Braintree Logan Express	Percent of responses
Didn't know about the Quincy Adams service	19%
Braintree is more convenient	26
Dedicated parking lot	13
Comfortable waiting areas	10
Waiting area and parking lot with a 24 hour attendant	11
New and comfortable buses	10
Other	11
Total	100%

SOURCE: 1991 Braintree Logan Express Survey.

both new and old users answered, about 49 percent responded "word of mouth."

Passenger surveys were used to determine that the market areas for the new and old locations were the same, yet the new location captured a much higher proportion of the market. The service moved on July 16, 1990. For the fiscal year ending June 30, 1990, Quincy Adams ridership was 120,817. By the fiscal year ending June 30, 1991, ridership had increased 26 percent to 152,266. In terms of market capture, prior to the relocation, the service captured about 13 percent of the 1,100 average weekday resident air passengers within its primary market area. After the relocation, the market share increased to 18 percent. The Framingham Logan Express captured 19 percent of the 1,200 average weekday resident air passengers in its market (33).

Changing Conditions and New Targets—The 1990s

Air passenger growth at Boston-Logan leveled off and even declined somewhat in the early 1990s. With the downturn in the regional economy, parking at the airport was no longer filling up. Meanwhile, the Logan Express services were meeting ridership expectations. With the relocation of the Quincy Adams service to a dedicated remote terminal location, ridership had increased dramatically.

Definition of the airport's ground access market was accomplished by combining the results of the latest air passenger and employee surveys. The identification of target market segments and the geographic origin of ground access trips helped Massport determine both the type of access service and the location for the service's boarding site. Using the results of market research allowed Massport to address ground access from the perspective of understanding those categories of airport users responsible for the greatest number of vehicle trips. Using employee and passenger survey data about ground access mode choice and data about vehicle trips, the various modes were arrayed in a continuum using an index that represented the number of vehicle trips per person for each access mode. Then, the two segments responsible for

the largest number of vehicle trips per person to the airport (air passengers who are dropped off or picked up and airport employees) were selected as targets of the ground access program. The objective was to encourage users of the two worst modes to use an alternative mode that generated fewer vehicle trips per person. Massport recognized that not everyone could use public transit; at least some improvement could be made by encouraging travelers to use various alternatives that had fewer negative impacts on the environment.

In 1992, a ground access strategy was adopted to encourage the use of high-occupancy transportation to and from Boston-Logan. The cornerstone of this strategy was a series of ground access initiatives including a new Logan Express service and a parking garage for employees to be developed off-airport. Analysis of survey and other information indicated that of the 37,400 passengers and employees arriving daily at the airport, 39 percent or 14,400 were either employees who parked at the airport or air passengers who were being picked up or dropped off.

Market Research as a Management Tool

The use of market research at Boston-Logan Airport illustrates its use as not only a planning tool but also a management tool. Market research has been used in each step of the planning process to address the airport's ground access problem. Airport market research has been used (1) to define the ground access problem, (2) to identify segments of the ground access market according to the access modes used, (3) to identify the geographic origins of ground access trips, and (4) to help in identifying the type of public transportation access service that would be an attractive alternative to specific segments of ground access travelers.

Airport market research can provide missing pieces of information that help explain changes that are observed but not understood. Air passenger and employee surveys provide a way of defining the characteristics of ground access travelers and also provide a means of communication between customers and Massport. Good market research means listening to customers as well as describing them.

CHAPTER 4

EXAMPLES OF SUCCESSFUL AIRPORT ACCESS SYSTEMS AROUND THE WORLD

This chapter presents summary descriptions of 14 of the most successful airport access systems in the world. For each of these systems, the combination of rail and bus services attracts more than 20 percent of air passenger market share. In each case, a key role is played by rail systems, and an additional key role is played by bus service. This chapter also references other systems for which comparable market share data are not currently available; these systems are ranked by their mode share to rail and bus services combined. For the examination of the European and Asian examples, shared ride services (such as door-to-door vans) play a very small role and have been uniformly excluded from this analysis.

This chapter presents a brief, factual overview of these international case studies. Chapter 5 presents the interpretation of these case studies for the U.S. practitioner who is considering the application of major investments in fixed guideways for airport access.

INTERNATIONAL AIRPORT ACCESS SYSTEMS: DEFINING THE KEY ISSUES

In the examination of the successful ground access systems, it is essential to observe the actual experience of the customer, who is traveling from his or her origin to his or her destination. This examination is concerned with the trip between the airport and the origin or destination of the passenger. In observing the nature of public transportation design, it is insufficient to focus solely at the line-haul segment of the trip. Rather, the user's modal choice is influenced by the extent to which the services function as a system, which is serving the needs of that passenger.

The deplaning air passenger experiences the following: first, the quality of the airport connection; second, the line-haul vehicle; and third, the distribution services between the line-haul vehicle's termination point and his or her actual destination. Dealing with baggage is another experience—a major concern of the passenger over the full trip is the need to deal with large and often heavy pieces of baggage. The choice of mode by the customer is made based on the cumulative experience influenced by these four factors compared with the cumulative experience offered by the competing mode.

This chapter reviews the experience of the 14 successful airport access systems in terms of four key factors, which

combined influence this cumulative experience. The four factors summarized are:

1. **Line-haul service.** Discussion of this factor concerns the line-haul travel characteristics of the public transportation modes that connect the airport to the downtown. Line-haul travel times are presented for the public modes and for taxis (as a surrogate for all auto modes). The price of the rail service is compared with the price of bus service, of taxis, and of parking for a hypothetical period of time. The section also includes a description of the rail vehicles used in the service.

2. **Integration with the regional transportation system.** The discussion of this factor includes a review of the relationship of the rail line-haul segment with the rest of the public transportation system. In many cases, this includes connections to other metropolitan systems; other systems are characterized by their relationship with national rail systems. In some cases, the line-haul vehicle is part of a metropolitan system and serves many local destinations directly. In other cases, the line-haul vehicle operates express service to a major terminal, from which connections must be made. The nature of the connections to the rest of the system is noted.

3. **Quality of the airport–rail connection.** The discussion of this factor examines the quality of the connection between the rail services and the airport check-in or baggage claim areas. Physical and architectural details are reviewed as relevant, and the physical quality of the transfer from the air passenger terminal to the rail system is described. Also noted is the nature of the configuration of the airport itself. The difference between centralized and decentralized airport layouts is examined.

4. **Baggage-handling strategy.** In the discussion for this factor, each airport access system is reviewed in terms of the strategies employed to deal with the baggage of the air traveler. Specific examples are presented for off-site check-in strategies, ranging from full-service downtown terminals to integration with other mechanisms for off-site check-in. When relevant, the status of such systems is summarized.

These four elements of a design strategy are also reviewed in the context of any known market data for each of the systems. Market characteristics include the extent to which the market is oriented to the downtown or to other areas well served by the regional rail system.

For each airport access system, a similar format is followed. An overview of the size and location of the airport is presented, followed by the mode share captured by rail and bus. The access system is then described in terms of the four factors. Market characteristics—the nature of the market served—is presented when the information is available.

The ranking of the top 14 systems is shown in Figure 4-1. Three additional systems—Rome, Copenhagen, and Stockholm—also have public transportation mode shares of more than 20 percent, but the available data preclude their inclusion in this phase of the analysis.

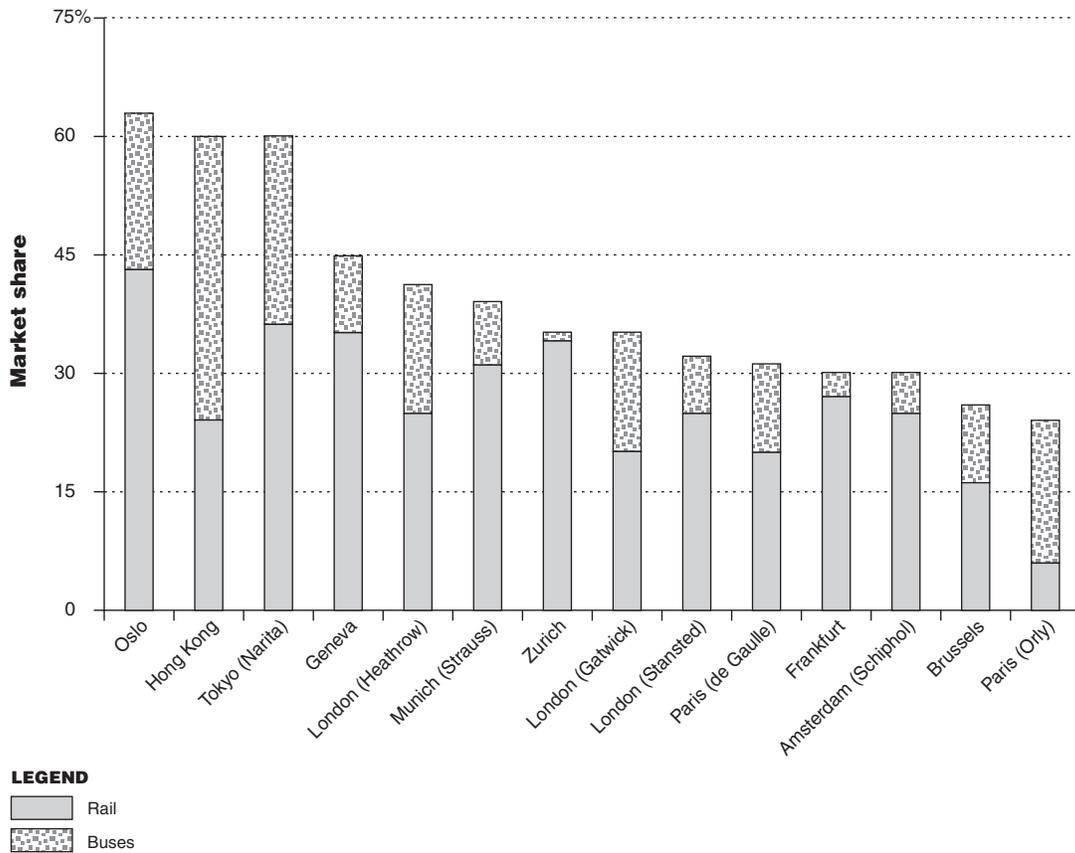
Ground Access System to Oslo Airport—63 Percent Market Share

Oslo’s new airport at Gardermoen (Figure 4-2) opened in 1998. The airport is 30 mi north of downtown Oslo and served approximately 14 million passengers in 1999. Travel time by taxi from Oslo to the airport is estimated to be 45 min.

Because the new airport is 30 mi from downtown Oslo, high-speed transit services have a market advantage over taxicabs and other modes of transportation. The Norwegian authorities set a policy goal of 50 percent market share capture for the combined rail services.

In addition to the financing of more than 12 billion Norwegian kroner (Nkr) (US \$1.5 billion) for the new airport, the government committed to the expenditure of Nkr 7 billion (US \$900 million) for the airport–rail connection. Of this, Nkr 5.6 billion (US \$720 million) was for the infrastructure and Nkr 1.4 billion (US \$180 million) for the rolling stock. Loans from the government financed 90 percent of the project’s total cost.

Line-haul service. Rail service between the airport and downtown Oslo was initiated in 1998. The airport is served both by a dedicated service entitled the Oslo Airport Express and by standard national railway service. In 1998, interim service was operated bypassing an incomplete tunnel section that is now providing a more direct route between the airport and downtown. The Oslo Express train is designed for 120-mph



Source: Matthew A. Coogan, based on information provided by airport management.

Figure 4-1. Market shares of rail and bus at international airports.

SOURCES:
Sources of mode share for this chart are presented in the airport summaries.
Matthew A. Coogan, based on information provided by airport management.

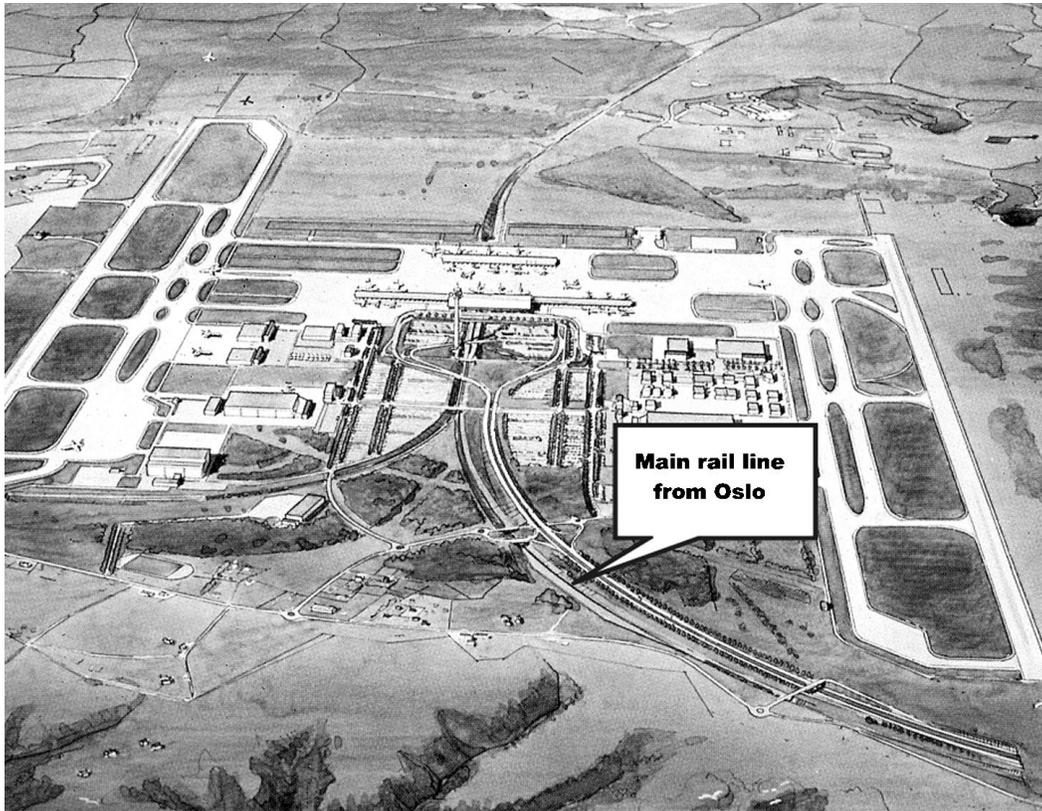


Figure 4-2. The new Oslo Airport at Gardermoen was designed as part of an integrated air–rail system.

SOURCE: Oslo Airport at Gardermoen, Norway.

operation, consistent with Norwegian intercity services. The train will make the 30-mi trip between the airport and downtown in 19 min. In the summer of 1999, the train took 33 min to reach the downtown Central Station from the airport; the fare for the trip was Nkr 90 (US \$11.60). This interim service by dedicated equipment attracted about 38 percent of the market, while standard national rail service attracted 5 percent for a 43 percent mode share—the highest rail mode share in this sample of public transportation access to airports in Europe and Asia (Table 4-1). For the interim service, four trains per hour were operating. Now there are six trains per hour in operation; of these six trains, three continue beyond Oslo's Central Station.

TABLE 4-1 Public transit access to Oslo Airport at Gardermoen

Mode	Market share (%)
Rail	43%
Bus	20
Taxi	5

SOURCE: Knut Blom Sorensen, Norwegian State Railways, Oslo Airport Express, Oslo, Norway, April 1999.

The rail vehicle was designed expressly for this service and was built by Adtranz in Norway. The train is designed for top speeds of 120 mph. The train has a unique seating arrangement, designed for the needs of the air traveler, as noted below in the section on baggage-handling strategy.

Airport bus service is offered with a 55-min travel time every 10 min, for a fare of Nkr 65 (US \$8.40).

Integration with regional transportation system. The Oslo Airport Express is a dedicated service for airport users and links the airport with Central Station, where good connections to the rest of the regional transportation system are available. The Norwegian Railway also provides additional services from the airport to the area southwest of Oslo and direct services from the airport to communities to the north. Local service to Oslo is also provided by the Norwegian Railway.

Quality of airport–rail connection. Oslo's airport was designed from the outset to serve as part of an integrated access system. The airport is centralized, with all gates served by a single landside terminal. Because of the natural geography of the airport site, the rail facility is at grade for most of the area. Passengers enter the air terminal basement with no grade change, as shown in Figure 4-3.



Photo: Matthew A. Coogan

Figure 4-3. At Oslo's airport at Gardermoen, the rail line goes directly under the air terminal building.

Escalator service is provided from the train station to the check-in and ticketing area of the airport. The walking distance from the baggage claim area to the rail platform immediately below is minimal. A comparison of the design of Oslo's airport-rail connection with the design of the rail connection at the Hong Kong airport is presented in Chapter 5.

Baggage-handling strategy. The Oslo Airport Express train was designed with a proactive strategy for baggage. The operation does not currently have an off-site baggage system, but it incorporates a unique seating layout, in which every seat faces a baggage-storage area. All seats served by each entrance door face the baggage-storage shelves.

The future of off-site baggage check-in is uncertain because of airline resistance and security concerns. Scandinavian Airlines System (SAS) now offers its passengers who have only carry-on baggage the option of automated check-in at Central Station.

Market characteristics. The managers of the Oslo Airport Express train estimate that some 48 percent of all air travelers are destined to the city of Oslo. Another 11 percent are

going to other towns in the southwest directly served by the rail service from the airport.

From the beginning, the managers of the Norwegian Railway understood the necessity of selling the rail ticket at the same time as the air ticket. The marketing strategy for the Oslo Airport Express focuses heavily on the needs of the business traveler, and extensive work has been undertaken with Norway's largest employers to sell tickets directly to these organizations. Some 58 percent of the rail passengers were traveling on business. Originally, the new product was branded with the word "Flytoget," which has since been replaced by the English language "Oslo Airport Express."

Ground Access System to Hong Kong International Airport—60 Percent Market Share

At Hong Kong International Airport (see Figure 4-4), located 21 mi from Hong Kong Island, a wide variety of ground transportation services are available. A taxicab ride to Hong Kong Island from the airport costs 350 Hong Kong dollars (HK \$) (US \$45.15). That ride takes 30 min under optimal conditions and much longer when the downtown roads are congested. A new regional highway system has been built to access the airport development area, with virtually no associated congestion or travel time delay.

Line-haul service. The Hong Kong Airport Express train departs from the airport every 8 min for three stations: Hong Kong (Central), Kowloon, and Tsing Yi. Travel time between the airport and Hong Kong (Central) is 23 min. Fares were initially established at HK \$70 (US \$9.05) to Hong Kong, HK \$60 (US \$7.75) to Kowloon, and HK \$40 (US \$5.15) to Tsing Yi. The Airport Express Line is operated by the Mass Transit Railway Corporation (MTRC). As shown in Figure 4-5, the new rail vehicles offer tall windows and a high level of passenger amenity.



Photo: Matthew A. Coogan

Figure 4-4. The rail station at the new Hong Kong International Airport has both an enplanement level and a deplanement level.



Photo: Matthew A. Coogan

Figure 4-5. Hong Kong's Airport Express Line trains offer large windows and seatback television.

The airport can also be reached by a bus connecting with the Tung Hung rail line, which was also built by MTRC as part of the integrated railway project serving the new development area around the airport. About 21 percent of air passengers choose the more expensive Airport Express Line service: about 3 percent take the shuttle bus to the less expensive Tung Chung Line service. As shown in Table 4-2, bus service at Hong Kong's airport has a higher mode share to bus than any other mode reviewed.

Bus service specifically designed for air passengers serves major hotel locations in Kowloon and Hong Kong. Airbus service focusing on hotel locations is provided for HK \$40 (US \$5.15), while a major transit operator, Citybus, has created a series of new bus routes with fares ranging from HK \$10 to \$18 (US \$1.30 to \$2.30).

Integration with regional transportation system. The Airport Express provides fast service, with 23-min travel time to the downtown. Major transfer functions are located at Tsing Yi Station, for connections in the northerly part of the system, and at Central Station, for connections to locations on

Hong Kong Island. (Kowloon Station does not connect with other rail lines.)

To address the need for distributing passengers to their destinations, the MTRC runs free buses to local hotels from Central Station and Kowloon Station. As will be discussed in Chapter 5, major design attention has been focused on the creation of high-quality transfers to taxis, at both Central Station and Kowloon Station.

Quality of airport-rail connection. Hong Kong Airport was designed to achieve optimized integration between rail and air facilities. All deplaning passengers retrieve their bags in one centralized arrival hall/customs facility located on the lower level of the airport terminal. From this facility, passengers walk across the arrival hall and board the train without changing levels. Conversely, the train brings all enplaning passengers to the upper level of the airport terminal, where they proceed through ticketing without changing levels.

Hong Kong's airport is designed to retain a compact, centralized configuration as the airport grows in scale. Currently, about 40 gates are served from the present landside terminal, which is located immediately adjacent to the Airport Express Line rail station. With further expansion, a second landside terminal will be built on the opposite side of the existing rail station, allowing some 100 gates to be served with one rail facility.

Baggage-handling strategy. MTRC developed the world's first downtown check-in system for use by all airlines. The system provides baggage check-in facilities at both Central Station and Kowloon Station. (One year later, the Heathrow Express opened a similar facility in London's Paddington Station.) All check-in functions, including the issuance of boarding passes, are undertaken at the downtown facilities staffed by airline personnel. Although the service is free, it is available only to those who have purchased a rail ticket, and its operation is subsidized by the rail system. Central Station started with 28 check-in positions of 45 potential positions, while Kowloon Station opened with 33 positions of 83 potential positions.

Market characteristics. The market for ground access services in Hong Kong is concentrated in a relatively small area. Of those passengers arriving at the previous Hong Kong airport, 40 percent were destined for the Kowloon Peninsula, while 33 percent were destined for Hong Kong Island. The rest were from the New Territories to the north. Of those passengers checking in, 17 percent had no bags checked. Another 27 percent had only one bag checked. Of those passengers on the new Airport Express train, 31 were resident air travelers and 39 percent were nonresident air travelers (34).

TABLE 4-2 Public transit access to Hong Kong International Airport

Mode	Market share (%)
Rail	24%
Bus	36
Taxi	5
Other (a)	16

(a) Hotel bus, tours.

SOURCE: R. Noble. "Hong Kong's Airport Express: Lessons from the First Two Months Operations." Paper presented at the Air Rail Conference, Frankfurt Germany, September 1998.

Ground Access System to Tokyo Narita Airport—59 Percent Market Share

The airport in Narita, located 40 mi east of downtown Tokyo, served 26 million passengers in 1997. The airport has

two terminals, each of which has a rail station. Travel by car between the airport and downtown varies from 90 min to several hours. Taxi fare can be as much as 22,000 yen (¥) (US \$180) for the trip.

Line-haul service. The JR East railway operates the Narita Express rail service every ½ hr. Coach, first-class, and super-first-class services are available for the 55-min trip to downtown. Fares on the Narita Express range from ¥2,444 (US \$20) to more than ¥4290 (US \$35). A private railroad company operates Keisei Railways Skyliner service for ¥1,880 (US \$15.40) to two downtown stations. The Narita Express captures 14 percent of the air traveler market; the Skyliner captures 10 percent. A third level of service is provided by more traditional transit trains, which offer a partial express service to downtown for under ¥854 (US \$7). The interior of the standard commuter train is shown in Figure 4-6. See Table 4-3.

Buses operate from the Tokyo City Air Terminal, where downtown check-in is offered for most airlines. The fare is ¥2,700 (US \$22.15). An airport shuttle operates to several downtown hotels for ¥2,900 (US \$23.75).



Figure 4-6. Standard commuter trains serve Tokyo Narita Airport.

TABLE 4-3 Public transit access to Tokyo Narita Airport

Mode	Market share (%)
Rail	36%
Bus	23
Taxi	n.a.

SOURCE: Narita Airport Authority, Tokyo, Japan. In communication to BAA (formerly British Airports Authority), March 1993.

Integration with regional transportation system. Between the two express services, three downtown rail stations are served. The local transit service from Narita has interconnections throughout the system. The Narita Express continues beyond the CBD to serve six more stations in the Greater Tokyo area.

Quality of airport–rail connection. Initially, Tokyo Narita Airport operated from a single air terminal, which was served by the stub end terminal of the rail lines. With construction of the new Terminal 2 complex, a second railroad station has been added at Narita. Both railroad stations are located in plazas beyond the access roadway, with walks of 500 ft. The stations are accessed via a mezzanine level under the airport roadway.

Baggage-handling strategy. The strategies for handling baggage vary considerably by service. The two major express rail services have baggage-storage areas on each vehicle; the rapid transit vehicle has no provision for baggage. A major downtown check-in terminal serves the airport buses, but not the rail systems.

Tokyo Narita Airport has a well-developed program for home delivery of bags that is operated by a private company.

Market characteristics. Tokyo Narita Airport provides an excellent example of the principles of market segmentation by price points. Not only are three levels of service offered by rail operating companies, but on the most popular—the Narita Express—there are three classes of seating. During peak travel periods, all seats on the Narita Express are often reserved days in advance, and only standby seating is sold at the airport. Given all the services offered, the air traveler arriving at Narita has a variety of reliable rail services ranging from ¥ 854 to ¥ 4,270 (US \$7 to \$35), for the same trip to downtown.

Ground Access System to Geneva International Airport—45 Percent Market Share

Geneva International Airport at Cointrin, which served 6.5 million passengers in 1998, is 3 mi northwest of downtown Geneva. A major mode transfer station has been built adjacent to the air terminal, as shown in Figure 4-7. Taxicab

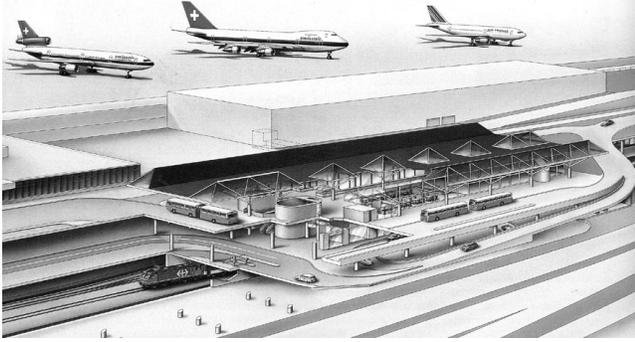


Figure 4-7. The rail and bus station at Geneva International Airport is located adjacent to the air terminal (shown on the left).

SOURCE: Geneva Airport Authority.

rides cost up to 35 Swiss francs (Fr) (US \$23.50), with about 10-min travel time to the center of the city.

Line-haul service. The Swiss Federal Railway train departs every 10 min, with a fare of Fr 5 (US \$3.35) to the central station at Geneva-Cornavin. The train on the main east–west line to Lucerne, Bern, and Zurich leaves the airport station every hour.

Buses to the airport are provided by the local transit agency. The buses depart every 10 min to the downtown and every 30 min to the United Nations complex. See Table 4-4.

Integration with regional transportation system. Geneva’s rail service can be characterized as part of the national system because the main national east–west line has its terminus at the Geneva Airport rail station. At Geneva’s central station, connections can be made for western France, including TGV service to Paris.

Quality of airport–rail connection. The Swiss Federal Railway airport station is located in a building immediately adjacent to, but separate from, the air passenger terminal, which is shown on the lower left of the diagram in Figure 4-7. The walking distance is about 500 ft. The enplaning passenger arriving by rail walks past the local bus curb, which is located between the rail station and the air terminal, as shown in Figure 4-8.

Baggage-handling strategy. The Swiss Federal Railway offers the Fly-Rail Baggage service to and from the Geneva

TABLE 4-4 Public transit access to Geneva International Airport

Mode	Market share (%)
Rail	35%
Bus	10
Taxi	22

SOURCE: Geneva Airport, as reported by Michael Pearson and included in the database of the International Air-Rail Association.



Photo: Matthew A. Coogan

Figure 4-8. Local bus service is located at the entrance to the train station at Geneva International Airport.

airport, which is discussed in the section describing the larger Fly-Rail Baggage operation at Zurich airport. The rail-based baggage system at Geneva carries one-quarter of the number of bags that were handled in the larger, older Zurich system.

Market characteristics. The rail station at the Geneva airport serves a distinctly national market. It is estimated that about 25 percent of the rail travelers boarding at the airport station are destined for the city of Geneva. Nearly 18 percent of the travelers are going to Lausanne, with most of the rest distributed around the French speaking areas of western Switzerland (35).

Ground Access System to London’s Heathrow Airport—40 Percent Market Share

London’s Heathrow Airport served 58 million passengers in 1997, making it the busiest airport in Europe. Heathrow is 15 mi west of London, with a driving time of 45 min to more than 1 hr. The taxi fare is 40 pounds (£) (US \$64).

Line-haul service. In 1998, BAA (formerly known as the British Airports Authority) began operating the high-speed Heathrow Express, which now captures more than 11 percent of the air passenger market. With another 14 percent of air passengers using the London Transport’s Underground Piccadilly Line, rail captures almost 25 percent of the passenger market at Heathrow Airport (see Table 4-5).

TABLE 4-5 Public transit access to London’s Heathrow Airport

Mode	Market share (%)
Rail	25%
Bus	15
Taxi	24

SOURCE: Unofficial estimates from BAA (formerly British Airports Authority) staff, summer 1999.

The Heathrow Express operates every 15 min on a 15-min journey from the airport to Paddington Station in London's West End. The new service, with a top speed of 100 mph, uses rail equipment built specifically for air travelers. The fare for the high-speed express service is £10 (US \$16).

The London Transport Piccadilly Line opened in 1977 and averages 20 mph, including station dwell times. This service takes 40 min to the closest parts of downtown London, with trip times including transfers of about 1 hr to farther downtown locations. The Piccadilly Line serves many popular destination areas directly, with excellent connections to the rest of the London Underground rail system. The Underground service costs £3.4 (US \$5).

A wide variety of bus services are operated from Heathrow Airport (Figure 4-9). In addition to many locally oriented bus routes, which largely are utilized by workers at Heathrow, specialized bus services to the downtown hotel areas have been developed. These services are marketed as the Airbus. The Airbus does not provide door-to-door service to hotels, but rather utilizes common shared bus stop locations. Two Airbus services link the central terminal area (Terminals 1, 2, and 3) and a third Airbus serves Terminal 4. The Airbus service costs £6 (US \$9).

Integration with regional transportation system. At present, the ground access system is oriented to central London and not immediately integrated with national rail services, as will be discussed in Chapter 5. A variety of strategies are now being implemented to connect various national rail lines



Photo: Matthew A. Coogan

Figure 4-9. Ridership is increasing on the many bus services to London's Heathrow Airport.

to Heathrow by specialized shuttle buses. In one study, of those using public transportation modes from Heathrow Airport to London, only 7 percent were connecting with the national railway system (36).

At its Paddington Station terminus, the Heathrow Express offers a hotel loop bus for £2 (US \$3).

Quality of airport-rail connection. In a complex design to serve Heathrow's scattered terminals, shown in Figure 4-10, the Heathrow Express uses a two-track tunnel to serve the central terminal area (which includes Terminals 1, 2, and 3); a single-track tunnel continues on to Terminal 4. The design allows for the later addition of a two-track tunnel to the planned Terminal 5 complex. The London Underground employs a one-directional loop between the central terminal area and the new Terminal 4. Although every attempt is made to explain which terminal to use, the existence of two stations is confusing to many users.

Because of timing issues, it was not possible to locate either rail station immediately under Terminal 4. Access to both lines is provided by underground walkways of about 500 ft. Longer walks are necessary from Terminals 1, 2, and 3, which share a common rail station in the central terminal area.

Baggage-handling strategy. Since June 1999, full off-site airline check-in service is provided at Paddington Station, the terminus for the Heathrow Express (Figure 4-11). Currently, 27 check-in positions are in use. Although the airlines pay the cost of renting their check-in positions, the Heathrow Express is responsible for getting the baggage to the airport and bears that cost.

There is little space to handle baggage on board the low-ceiling Piccadilly Line trains, and Underground stations are not designed for people with baggage. The Heathrow Express vehicles have large baggage-storage areas on board because there is no form of baggage-check service coming into the city.

Market characteristics. Ridership of the London Underground service is 62 percent airline passengers, 11 percent airport employees, 15 percent meeters and greeters, and 12 percent those with business in the airport vicinity. Only 5 percent of airport employees use the Underground (37).

It was predicted that 60 percent of riders on the Heathrow Express would be visitors to the area rather than residents of the area. Market studies predicted that 60 percent of area riders would be traveling for business with 40 percent traveling for other trip purposes. Almost 90 percent of Heathrow Express users are destined for central London, which is defined as the area serviced by the Circle Line (38).

Ground Access System to Munich Franz Josef Strauss Airport—39 Percent Market Share

Munich Franz Josef Strauss Airport (Figure 4-12) is located 17 mi north of downtown Munich and served 19 million airline passengers in 1998. From its opening in 1992, the airport was served by one line of the suburban rail system known as the "S-Bahn." In 1998, the German Federal Rail-

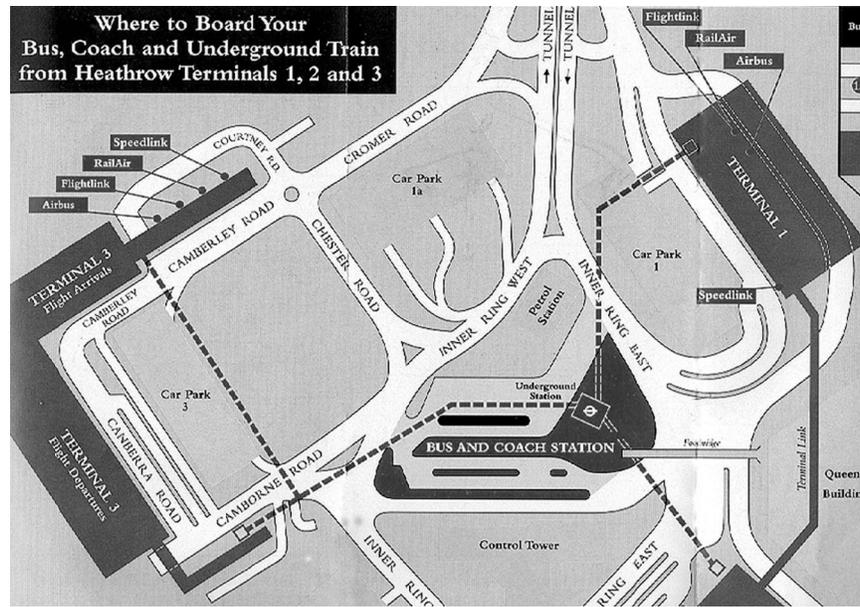


Figure 4-10. Heathrow Airport's Terminals 1, 2, and 3 are connected by underground walkways to the bus and train station.

SOURCE: Heathrow Airport Limited.

road (Deutsche Bahn) inaugurated a second rail service to the Munich airport. When the airport was served by only one rail line, rail captured 28 percent of the air passenger market. By January 1999, the ridership on the two lines together increased to 31 percent market share. Taxi service to the downtown central train station costs more than 100 deutschemarks (DM) (US \$55), and can take about 40 min.

Line-haul service. The original rail service was provided every 20 min via the eastern downtown station (31 min travel time), through City Hall Square (37 min), and Main Station (40 min). The second service also provides 20-min headways

following the opposite route, with service via Main Station (40 min), through City Hall Square (43 min), and to the eastern downtown station (48 min). In the common downtown distribution section, service is provided every 10 min. However, rail passengers have to monitor train departures in two directions to catch the first train to the airport. A one-way ticket on either line costs DM 14 (US \$7.70). Soon the airport will be served by new, double-decked rail cars with a much higher ratio of seats to standees.

The city bus, which goes to Main Station every 20 min, has a travel time of 45 min and a fare of DM 15 (US \$8.25). See Table 4-6.

Integration with regional transportation system. The rail connections at the Munich airport can be characterized as being metropolitan rather than national in nature. The airport is served by two metropolitan rail lines, but not by any national service. Most connections with national rail services are made at Main Station, which is about 40 min from the airport by either of the two rail lines.

By contrast, each of the two S-Bahn lines provides downtown distribution to nine stations and direct transfer to all of the lines in the extensive rail network serving the metropolitan area.

Quality of airport-rail connection. The airport rail station was constructed as part of the new airport, and thus benefits from architectural integration with the airport terminals. Enplaning passengers arriving by rail take an escalator from the platform to a mezzanine level (shown in Figure 4-13), where a check-in facility is provided for several, but not all, airlines. A second escalator goes to the terminal level. Although the



Figure 4-11. London's Paddington Station has been rebuilt to serve as the downtown terminus of the Heathrow Express.

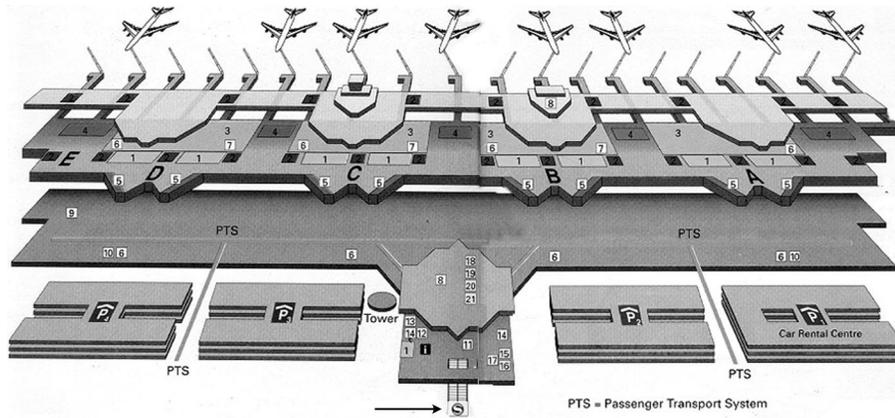


Figure 4-12. The S-Bahn Station (denoted with the “S” symbol at the bottom of the diagram) is located inside the air terminal at the Munich Franz Josef Strauss Airport. SOURCE: Munich Airport Authority.

connection brings the rail passenger directly into the terminal structure, the configuration of the terminal calls for long walking distances within the building. The long, linear air terminal building has several curbside drop-off locations, which are close to the departure gates. For most of the airline gates, the walking distances from parking and from curbside drop-off are considerably shorter than the walking distance from the rail transit station. German rail authorities have noted that the pedestrian access to the parking facilities is superior to the access provided to the rail station.

Baggage-handling strategy. A downtown check-in station for Lufthansa passengers now serves only those passengers with carry-on baggage. Baggage space on the rail line varies by time of day and by level of crowding on the commuter systems.

Ground Access System to Zurich Airport—35 Percent Market Share

Zurich Airport at Kloten, which served 19 million air passengers in 1998, is 7 mi from downtown Zurich. The airport terminal is serviced directly by the Swiss Federal Railways

station, shown in Figure 4-14. The drive to downtown can take about 20 min, with taxi fares of Fr 50 (US \$33.50).

Line-haul service. The trains from the airport to downtown Zurich leave approximately every 10 min, have a 10-min travel time, and cost Fr 7.5 (US \$5). See Table 4-7.

Integration with regional transportation system. The Zurich rail system can be characterized as being part of a national system, which operates as a shared system. No trains are operated solely to serve the airport, and all trains are part of a longer route. The Zurich Airport rail station is near the eastern end of the major east–west trunk railway, which offers service every hour to Geneva at the western tip of the country. Coordination with the aviation sector has been optimized (e.g., when a Swissair flight is rerouted to Zurich Airport from Geneva, connections are offered to the passenger on the hourly rail system).

TABLE 4-6 Public transit access to Munich Franz Josef Strauss Airport

Mode	Market share (%)
Rail	31%
Bus	8
Taxi	10

SOURCE: Munich S-Bahn Management, Deutsche Bahn, Munich, Germany, May 1999.



Figure 4-13. The S-Bahn rail platforms are located under this mezzanine station, which includes a check-in facility for rail users.

Photo: Matthew A. Croghan

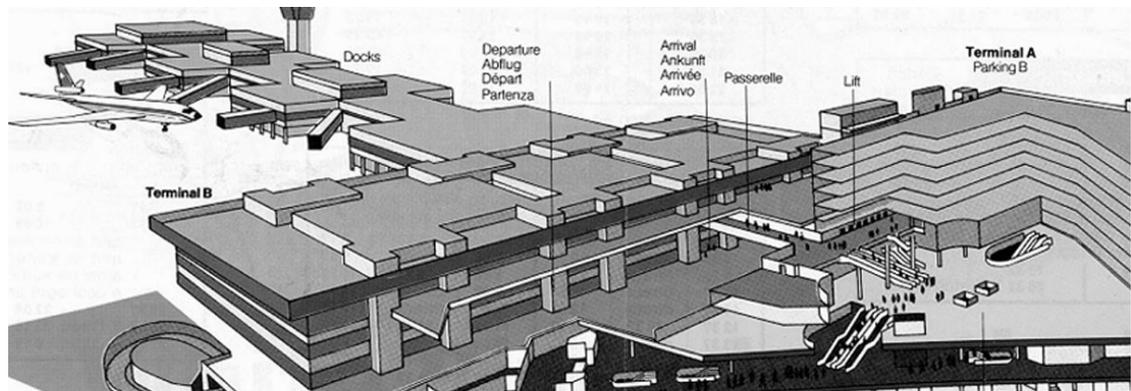


Figure 4-14. The Swiss Federal Railways Station is located under the air terminal complex at the Zurich Airport.

SOURCE: Zurich Airport.

Quality of airport–rail connection. The compact configuration of Zurich Airport allows for direct connection from the rail station to both Terminals A and B. In fact, the two terminals are now being joined together to create one common departure area for most passengers. This design characteristic is discussed in Chapter 5.

Baggage-handling strategy. Zurich Airport is served by the most comprehensive off-site baggage and passenger check-in system in the world, known as the Fly-Rail Baggage program. Baggage can be checked in at 116 rail stations throughout the country for most scheduled flights, with the exception of some flights to the United States. This service costs Fr 20 (US \$13.40) per bag. Swiss Federal Railway will accept bags as late as 3 hr before flight time in the downtown Zurich train station and requires up to 16 hr at isolated Alpine stations. Check-in for passengers in the Swissair alliance is available at 23 railroad stations.

At Zurich Airport, specially designed baggage carts are allowed on the escalators and on the rail platforms, as shown in Figure 4-15.

Market characteristics. The access system for Zurich Airport has been structured around the needs of the longer-distance rail user, and the mode shares attained for various geographic market segments support this. Of those passen-

gers coming from national destinations, more than 50 percent choose to come by rail. For example, the market share from the national capital, Bern, a city 75 mi from the airport, is about 60 percent. Conversely, from the immediate bedroom suburbs, only about 8 percent of air passengers select the rail option to get to the airport. Of all riders at the Zurich Airport rail station, about 40 percent are going to the Zurich metropolitan area, with 60 percent traveling longer distances (39).

Ground Access System to London Gatwick Airport—35 Percent Market Share

Gatwick Airport is 30 mi southwest of central London; travel takes more than 1 hr by car. Taxicab service costs between £35 and £40 (US \$56 to \$64), depending on the time of day and on other factors. Gatwick Airport served 27 million passengers in 1998.

Line-haul service. Gatwick Airport is part of one of the first integrated air–rail projects in the world. At present, rail

TABLE 4-7 Public transit access to Zurich Airport

Mode	Market share (%)
Rail	34%
Bus	1
Taxi	24

SOURCES:

Zurich Airport *Untersuchung des Landseitigen Verkehrs*, Herbst 1989, Zurich, Switzerland.

Erhebung landseitiger Verkehrs Herbst 1994.



Photo: Matthew A. Coogan

Figure 4-15. Baggage carts are allowed on escalators and on the rail platform at Zurich Airport.

services attract about 20 percent of air passengers. The airport is served by both shared and dedicated rail services. The dedicated service, called the Gatwick Express, runs to London's Victoria Station, shown in Figure 4-16. The nonstop service to Victoria Station, which takes about 30 min, runs every 15 min from 5 A.M. to 1 A.M. New 25-min service was planned with the arrival of new railway cars in late 2000. The Gatwick Express costs just more than £10 (US \$16.00) for a one-way ticket. See Table 4-8.

In addition to the dedicated Gatwick Express service, a variety of shared services are operated. The Connex South Central Railway runs a near-express service (it has a 35-min travel time) as part of a larger commuter corridor service. The service is not dedicated to airport users, who therefore must compete for space on the trains with commuters. Five trains are operated per hour, at a fare of £7.5 (US \$12). In addition, the Thameslink railway serves destinations in London's financial district, operating to London Bridge Station and Kings Cross Station for £9.5 (US \$15.20) at similar running times. Bus service is operated to Victoria Station every hour, with more than a 1-hr travel time. The fare to Victoria Station is £7.5 (US \$12).

Integration with regional transportation system. Gatwick Airport is served by one express service to a downtown terminal and by a variety of services integrated into larger rail systems. Direct national rail lines serve cities to the south such as Southampton. Additional service goes to Northampton and the new town of Milton Keynes.

Quality of airport-rail connection. For those arriving at Gatwick's South Terminal, the walk from customs clearance to the mezzanine level above the station is less than 500 ft, shorter than the walk to the automobile curb or garage. For those arriving at the new North Terminal, baggage claim is less than 200 ft from the people-mover shuttle to the original terminal complex. Gatwick Express managers have encouraged Gatwick Airport management to allow the use of bag-

TABLE 4-8 Public transit access to London Gatwick Airport

Mode	Market share (%)
Rail	20%
Bus	15
Taxi	12

SOURCE: *Passengers at Birmingham, Gatwick, Heathrow, London City, Luton, Manchester, and Stansted Airports in 1996*, CAT 677, Civil Aviation Authority, London, England, 1997.

gage carts on the people mover, which is not usually allowed at major airports. The baggage carts, however, cannot be taken beyond the mezzanine level of the rail station to the rail platforms below.

Baggage-handling strategy. Users of rail service to London benefit from the extensive baggage check-in services at Victoria Station in downtown London. Several airlines, including British Airways, American Airlines, and Canadian Airlines International, provide full check-in services, including the issuance of boarding passes. At Victoria Station, good connections are available to taxis, buses, and several Underground lines. Managers estimate that 25 percent of the long-distance flight passengers use the baggage service; very few domestic air passengers use the service.

Market characteristics. The dedicated Gatwick Express dominates the market to central London, capturing 60 percent of that market, with the shared rail getting 7 percent. Buses gain 15 percent, and taxis gain only 8 percent. The private car gets only 10 percent. Of those riding the train, 71 percent are air passengers (40).

In the years immediately following the opening of the airport in 1958, rail services captured 40 percent of all air passengers. Over time, the composition of the market has changed. In its early years, Gatwick served a market dominated by lower-cost charter operations. Overall market share to rail fell as Gatwick became a full-service international airport.

Ground Access System to London Stansted Airport—34 Percent Market Share

Stansted Airport, whose the rail station is shown in Figure 4-17, is located 35 mi north of London, with about 70 min travel time by automobile. Taxi fare for the journey is £45 (US \$72). Stansted served 7.2 million passengers in 1998 and is growing rapidly.

Line-haul service. Stansted Airport is served by both dedicated services to London and shared services in the region. The dedicated service to London, called the Stansted Skytrain, operates every half hour from Liverpool Station, with about a 40- to 45-min travel time to the airport. In 1999 the service was rebranded as the Stansted Express with 15-min



Figure 4-16. The Gatwick Express operates every 15 minutes to London Gatwick Airport from its downtown terminus at Victoria Station.



Figure 4-17. The rail station at London Stansted Airport is located under the air terminal.

SOURCE: London Stansted Airport, BAA (formerly British Airports Authority).

service offered for much of the day. The fare is £10 (US \$16). Hourly local service between the airport and London is also provided. Additional services are provided directly to the Midlands and destinations in the north of England. Rail captures 27 percent of the air passenger market. Airport buses also operate to Victoria Station. See Table 4-9.

Integration with regional transportation system. A variety of regional transportation services are offered from Stansted Airport. Each of the express trains to Liverpool Street, in the eastern area of London, also stops at the Tottenham Hale London Underground station, which offers good connections to destinations in the popular West End district. Direct service to Cambridge and other areas to the north has been improved over the last few years.

Quality of airport–rail connection. Stansted Airport has a centralized configuration, with a compact landside terminal serving a series of airside concourses via a people-mover link. The rail station is integrated into the basement of the terminal structure at Stansted Airport, as shown in Figure 4-17. The rail station is accessed by elevator, escalators, and ramps. The escalators from the rail station are located in the departures concourse; the escalators to the rail station are located in the arrivals concourse. The bus station is across the airport roadway, in a central plaza.

Baggage-handling strategy. The dedicated trains of the Stansted Express are designed with ample luggage storage

TABLE 4-9 Public transit access to London Stansted Airport

Mode	Market share (%)
Rail	27%
Bus	7
Taxi	8

SOURCE: Personal communication with J. Chattfield, Brand Manager, Stansted Skytrain, London, England, April 1999.

areas on board. The concept of downtown check-in at Liverpool Street is being explored by the operators of the Stansted Express along with the airlines and the owners of the rail station.

Market characteristics. Managers of the rail system have seen a significant rise in mode share to rail, from less than 10 percent to more than 25 percent in the last decade. Analysts note that, in the past, the users of Stansted Airport did not tend to come from the London area. Market data showed that, for the small portion of users who did come from central London, their mode share to rail was extremely high, at a capture rate of more than 50 percent. Over the past 5 years, a greater proportion of Stansted air travelers are now coming from London, resulting in a higher overall mode share for rail.

Ground Access System to Paris' Charles de Gaulle Airport—31 Percent Market Share

Located 15 mi north of Paris, Charles de Gaulle Airport is the dominant airport not only in Paris, but also in France. The airport's passenger volume was 35 million in 1998. A rail station has been built in the center of a new air terminal complex, shown in Figure 4-18. Ground access time on the motorways from downtown Paris varies from 30 min to more than 1 hr in heavy congestion. Taxi fares are 220 French francs (F) (US \$36.30).

Line-haul service. The airport is served by both metropolitan and national rail services. The electrified suburban rail network, known as the RER Line B, provides service every 15 min to downtown, with direct service to many downtown stations that offer high-quality connections to the rapid transit system. The RER Line B provides a 35-min travel time from the airport to downtown Paris. The second-class fare is F48 (US \$7.90). Rail service captures about 20 percent of the air passenger market; buses capture about 11 percent. See Table 4-10.



Photo: Matthew A. Coogan

Figure 4-18. Platforms for both high-speed and suburban rail services are located in this multilevel space in the Terminal 2 complex of Paris' Charles de Gaulle Airport.

TABLE 4-10 Public transit access to Paris' Charles de Gaulle Airport

Mode	Market share (%)
Rail	20%
Bus	11
Taxi	33

SOURCE: Aeroports de Paris, from a 1999 interview with Leigh Fisher Associates.

Bus service is provided by Air France and the local public transit operator, the RATP. The Air France bus costs F60 (US \$9.90) between the airport and downtown; the “Roissybus” to the bus station next to the opera house costs F45 (US \$7.45).

Integration with regional transportation system. Over the last decade, integration with the national rail system has been the investment focus at Charles de Gaulle Airport. For years, the air traveler connecting to the national rail system had to proceed to one of the many (unconnected) downtown rail stations in order to board a connecting train to other destinations in France. With the creation of a new loop line around Paris that serves the airport, the air traveler is now offered direct service from airport Terminal 2 (Figure 4-19) to cities such as Lyons (2 hr) and Brussels (1.5 hr). Thus, Charles de Gaulle Airport offers services similar to those offered in the airports in Oslo, Frankfurt, and Zurich—services that emphasize high-quality integration with national rail lines. Concurrent with the investment in linking rail and air services, the total share captured by rail at Charles de Gaulle has increased to 20 percent.

Aeroports de Paris is currently working with the national railroad authority to create a new, express service into Paris, reportedly with an 18-min travel time.

Quality of airport–rail connection. A shuttle bus connects Terminal 1 with the original RER station, which is 1 mi away. In 1998, a second rail station incorporating both high-speed national service and the regional RER was opened in



Photo: Matthew A. Coogan

Figure 4-19. Paris' Charles de Gaulle Airport was the first to offer high-speed rail service.

the new Terminal 2 complex. The long-term plans for the airport call for the creation of a people-mover system, as will be discussed in Chapter 5. Currently, Terminal 1 is connected to the rail stations by a shuttle bus.

Baggage-handling strategy. There is currently no downtown check-in facility in Paris to replace the original City Air Terminal at Gare des Invalides on the Left Bank. There are no dedicated areas for baggage on the RER trains, which are overcrowded during rush hours. The long-distance TGV train has excellent baggage storage, and plans are under consideration for off-site check-in services.

Ground Access System to Frankfurt International Airport—30 Percent Market Share

Frankfurt Airport, shown in Figure 4-20, served 40 million passengers in 1997, making it the second busiest airport in Europe after London's Heathrow. The airport is 6 mi from downtown Frankfurt; travel time is about 20 min by automobile. Taxi service to downtown costs DM 40 to DM 50 (US \$22.05 to \$27.55), depending on the destination.

Line-haul service. Frankfurt's airport is currently served by the regional suburban railway—the S-Bahn—and national rail service on a trunk line between Frankfurt and Cologne. An additional rail station opened in 1999 for use by the national high-speed rail system, called the InterCity Express (ICE).

The S-Bahn provides suburban rail service to Frankfurt and Mainz, with a 10-min travel time to downtown at a fare of DM 6 (US \$3.30). Nine local bus routes serve the airport, with Lufthansa regional bus service to Heidelberg, Mannheim, and Talheim. See Table 4-11.

The new second rail station, which is shown in Figures 4-20 and 4-21, serves the new German high-speed rail system. This new station is being built to provide space for four separate lines of the German high-speed rail network, which will pro-



Figure 4-20. Frankfurt International Airport is now served by a new second rail station (left), which provides high-speed rail service.

SOURCE: Frankfurt Airport Main AG, 1999

TABLE 4-11 Public transit access to Frankfurt International Airport

Mode	Market share (%)
Rail	27%
Bus	3
Taxi	11

SOURCE: Flughafen Frankfurt Main, Planning and Department, Frankfurt, Germany, 1992.

vide significantly improved travel times in all directions. For example, rail travel time to Cologne will decrease from 2 hr to 1 hr with the construction of a totally new rail alignment to the east of the Rhine River. The new rail station will have its own airline check-in facility.

Quality of airport–rail connection. The existing rail station is located in the basement of Terminal 1 and provides direct escalator access to a large mezzanine level, where the platforms are accessed. The new high-speed station is about 1,000 ft from the existing Terminal 1. Currently, all rail users must access the new Terminal 2 by entering Terminal 1 and taking a people mover. As will be discussed in Chapter 5, a



Figure 4-21. High-Speed German ICE trains now serve the new rail station at Frankfurt International Airport.

SOURCE: Frankfurt Airport.

major effort is being made to improve the quality of connection between the new rail station and both air terminals.

Ground Access System to Amsterdam's Schiphol Airport—30 Percent Market Share

Schiphol Airport, Europe's fourth largest airport, served 25 million passengers in 1998. With metropolitan rail service, national rail service, and some international high-speed rail services, Schiphol Airport is served by one of the widest varieties of high-quality public transportation modes of any airport in the world. The rail station is integrated into the main arrival hall, as shown in Figure 4-22. About 25 percent of Schiphol's air passengers access the facility by rail. Schiphol Airport is 9 mi west of downtown Amsterdam, on the major east–west rail line, which also serves the Hague and Rotterdam. A taxicab ride takes about 30 min from the airport to downtown Amsterdam, at a fare of more than 50 guilders (G) (US \$24.50).

Line-haul service. The combined rail system provides service every 15 min throughout most of the day, with a 15- to 20-min travel time to Amsterdam Central Station. The fare is G6 to G7 (US \$2.95 to \$3.45) between the airport and downtown. KLM-Royal Dutch Airlines operates bus service to several in-town hotels, charging G15 (US \$7.35). See Table 4-12.

Integration with regional transportation system. Although the local rapid transit lines do not serve the airport, the national railway system operates high-frequency services throughout the country, meeting the needs of local commuters. Therefore, service to Rotterdam or the Hague is offered as frequently as many traditional airport services to the dominant CBD. This strategy, which serves destinations throughout the country, is similar to that adopted in Switzerland. An example of a double-decked national railway train is shown in Figure 4-23.

Services to international destinations are provided both by traditional intercity trains and by the high-speed Thalys train. At standard intercity speeds of 125 mph, this train cur-



Figure 4-22. The rail platforms at Amsterdam's Schiphol Airport are immediately below this arrival hall.

Photo: Matthew A. Coogan

TABLE 4-12 Public transit access to Amsterdam's Schiphol Airport

Mode	Market share (%)
Rail	25%
Bus	5
Taxi	12

SOURCE: "Amsterdam's Schiphol Airport," paper presented by R. Niblett, C. Buchanan, and Partners at PTRC European Transport Forum, Brunel University, England, September 1996.

rently operates between Cologne, Germany, to the east and Brussels, Belgium, to the west. Between Brussels and Paris, the train operates at speeds of up to 180 mph as part of the TGV system.

The public transportation user, therefore, has access to metropolitan service, national service, and high-speed international service from a point only a few hundred feet from baggage claim and customs clearance.

Quality of airport-rail connection. Schiphol Airport was reconstructed to create a common arrivals area adjacent to three baggage claim areas. The rail platforms are located directly under this common area. Even though the design evolved from the construction of separate terminal buildings, the main arrival hall functions occur near the rail and bus departure areas.

Baggage-handling strategy. Currently, there are no off-site baggage check-in facilities in the Netherlands. However, planners in the Netherlands are examining a variety of off-site check-in strategies as part of the environmental process for further expansion of Schiphol Airport. A variety of off-site terminal concepts, including access by dedicated buses, are currently under examination. Because most of the trains serving the airport are designed for national services, adequate areas for baggage storage are usually provided.



Figure 4-23. This bilevel car serves Amsterdam's Schiphol Airport with high-frequency national service.

Ground Access System to Brussels International Airport—26 Percent Market Share

Brussels International Airport served 19 million passengers in 1998. About 16 percent of those air travelers accessed the airport by rail. A taxi to the city from the airport costs more than 1,000 Belgian francs (FR) (US \$26.50) and takes the same amount of time as the rail service.

Line-haul service. Brussels Airport is served by a spur of the main rail line, from the three downtown stations—North, Central, and Midi—every 15 min throughout the day, with half-hour headways on the weekends. Travel time is about 20 min to the nearest downtown terminal and 30 min to the farthest. A standard (second-class) ticket costs FR 90 (US \$2.40). See Table 4-13.

Integration with regional transportation system. The Brussels rail service was designed as a stub end of a suburban rail line. Virtually all national and international connections are made by changing trains downtown at Central Station or North Station. However, direct service is provided beyond downtown Brussels to a small number of southwest and northwest destinations in Belgium.

Quality of airport-rail connection. The rail station is at the far end of the original airport terminal, with a walk of more than 1,000 ft for access to the farthest air terminal building.

Baggage-handling strategy. A downtown check-in station, which carried baggage by airline coach, has been discontinued. Ample baggage space is provided on the national railway train, which serves the airport.

Ground Access System to Paris Orly Airport—26 Percent Market Share

Paris' Orly Airport is 9 mi south of the center of Paris and serves the southern suburbs of Paris. The airport served 25 million passengers in 1998. Travel time between the airport and the center of Paris on a combination of motorway and local streets can be as low as 25 min but can fluctuate significantly. A taxi ride to the city center costs F155 (US \$25.60).

Line-haul service. Orly Airport is served by connecting services to two separate metropolitan rail lines. A people mover, shown in Figure 4-24, connects the two air terminals with the newer RER Line B. At the cost of F57 (US \$9.40), a combined ticket is issued through to Paris on the OrlyVal people mover. A shuttle bus connects to an older rail line, called the RER Line C, for a fare of F32 (US \$5.30). A variety of bus services are

TABLE 4-13 Public transit access to Brussels International Airport

Mode	Market share (%)
Rail	16%
Bus	10
Taxi	20

SOURCE: Leigh Fisher Associates.

offered, including an Air France bus with service through Paris' Left Bank. This service is provided every 20 min all day between the center of Paris and Orly, at a cost of F45 (US \$7.45). The Orlybus connects to a nearby rapid transit station, with a total cost of F35 (US \$5.80) and a 45-min travel time. The "Jet-bus" connects to a different transit station and costs F26 (US \$4.30). See Table 4-14.

Integration with regional transportation system. Travelers with destinations served by the national railway must make connections at the appropriate downtown rail terminal. At present there are no plans to provide direct national rail services at Orly Airport.

Quality of airport–rail connection. The OrlyVal people mover has two stops at the airport, allowing elevated pedestrian bridge connections to both passenger terminals. On the trip to the airport, passengers can transfer from the RER Line B to the people mover without changing platforms; however, on the return trip, passengers must change platforms to connect from the people mover to RER Line B. The connection to the RER Line C is via a 5-min shuttle bus, which operates on a short reserved right-of-way segment to avoid traffic congestion.

Baggage-handling strategy. As noted for Charles de Gaulle Airport, the RER Line B is poorly structured to handle the baggage of airport users. Initially, the OrlyVal people mover did not have any baggage-storage space, as show in Figure 4-24. The people movers were then redesigned to provide some space for baggage. Bus lines operated by Air France have ample baggage-storage capacity under the floor of the coach; other buses have only a moderate amount of storage area in the vehicle.

AIRPORTS WITH NEW RAIL SERVICE (NO SURVEY DATA AVAILABLE)

Ground Access System to Copenhagen Airport (1998)

Copenhagen Airport served 16 million passengers in 1998. The airport is located in Kastrup, 7 mi southwest of down-



Figure 4-24. Initially, the OrlyVal people mover did not have provision for baggage.

TABLE 4-14 Public transit access to Paris Orly Airport

Mode	Market share (%)
Rail	14%
Bus	12
Taxi	31

SOURCE: Aeroports de Paris, from a 1999 interview with Leigh Fisher Associates.

town Copenhagen. Taxi service from the airport to downtown takes about 15 min and costs 140 Danish kroner (DKr) (US \$20.25). The overall layout of the airport, including the rail station connected with Terminal 3, is shown in Figure 4-25.

Line-haul service. Rail service began in fall 1998 and operates every 20 min, with a 12-min travel time to Central Station for DKr 16.5 (US \$2.40). The service continues on to Helsingor and other cities, providing national rail access to the airport. Passengers on other national services are provided with transfers at major stations, including Central Station. In July 2000, the rail service was inaugurated through a new bridge and tunnel to southern Sweden.

Until 1999, airport bus service to Central Station had been provided every 15 min in association with SAS—the largest airline. The SAS bus charged DKr 35 (US \$5.05) for the 20-min ride. As a result of the introduction of rail service to downtown, the SAS bus to downtown has been eliminated. The city transit agency runs a bus to Central Station downtown, charging DKr 16.5 (US \$2.40). Direct bus service is also operated between the airport and the south of Sweden. Before the rail service was initiated, the bus system captured 28 percent of the air traveler market.

Integration with regional transportation system. The investment in rail at Copenhagen Airport is part of a massive program to provide improved rail services to destinations throughout Denmark and Sweden. Connections to Sweden will be pro-

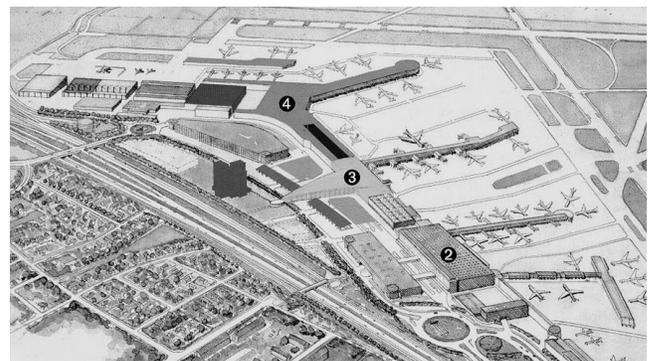


Figure 4-25. An overview of Copenhagen Airport, with the rail station at Terminal 3.

SOURCE: Copenhagen Airport.



Photo: Matthew A. Coogan

Figure 4-26. Rail service to Denmark and Sweden is routed through the basement of Copenhagen Airport's Terminal 3.

vided over a new 18-mi bridge-and-tunnel system, as will be described in Chapter 5.

Quality of airport-rail connection. As shown in Figure 4-26, the new Terminal 3 has been designed to include an architecturally ambitious integrated air-rail terminal complex. A new check-in facility has been opened in the rail station lobby of Terminal 3. A new baggage claim and customs clearance center for the airport has been built as part of the new Terminal 3 complex, which is discussed further in Chapter 5.

Baggage-handling strategy. No off-site check-in services are planned in Denmark. The future of airport check-in facilities in Malmo, Sweden, is currently under discussion. New rail equipment for the cross-sound service will have flexible areas in the center of the train, to serve airport users and bike riders.

Ground Access System to Stockholm's Arlanda Airport (1999)

Stockholm's Arlanda Airport inaugurated a new ground access system in November 1999. The airport carried 15 million passengers in 1998. It is located 25 mi from downtown Stockholm. A taxi ride takes 35 min and costs 410 Swedish kroners (SKr) (US \$50).

Line-haul service. The Arlanda Express rail line is a privately funded and privately managed venture that offers high-speed rail connections between Arlanda Airport and downtown Stockholm. At the airport, there are two rail stations by the Arlanda Express and a third station operated by the Swedish state railways. The closest station is about 17 min from downtown Stockholm, with a fare of 120 SKr (US \$14.60). The local airport bus service, called Flybus, continues to operate from the airport to downtown, in competition with the two train services.

The project cost SKr 5 billion (approximately US \$600 million) and utilizes rolling stock provided by GEC Alsthom. The trains are designed for the European standard of 120 mph, but initially are operating at no more than 100 mph.

Integration with regional transportation system. In addition to the services to downtown operated by the private consortium, service through the new airport tunnel is also operated by the state railway, which pays the consortium a track-usage fee. The state railway operates out of a single terminal, serving only state railway trains. Standard intercity services are provided to national destinations and to downtown Stockholm.

From the beginning of the project, managers of the Arlanda Express worked on creating high-quality intermodal connections with the rest of the regional transportation system. The downtown rail station was reconstructed so that the track closest to the local street curb is dedicated to the Arlanda Express, with taxi access immediately adjacent.

Quality of airport-rail connection. The airport configuration causes the Arlanda Express to have two stations: a first for Terminals 2, 3, and 4, and a second for Terminals 5 and 6.

Baggage-handling strategy. Initially, the main railway station in Stockholm will offer three self-service machines and four counters for airline check-in for those who do not need to check baggage. In late 2000, the Arlanda Express plans to offer full check-in at 18 positions.

Market characteristics. The Arlanda Express will benefit from the elaborate mechanism for multimodal ticketing and information already in place throughout Sweden, as will be described in Chapter 5.

A complex ticketing system, with half fares for children and discounted fares for students and pensioners, is being developed. A family fare—equivalent to the fare for two adults—is offered for two adults and all children traveling. A fare of SKr 180 (US \$22) for round trips that take place in under 4 hr has been designed to attract meeters and greeters.