CHAPTER 5

LESSONS LEARNED FROM SUCCESSFUL RAIL SYSTEMS

OVERVIEW

Chapter 4 summarized the results of a review of 14 successful airport ground access systems, each of which was able to capture more than 20 percent of the market of air travelers to public transportation. Chapter 5 examines the attributes achieved in the implementation of the successful system that can be of use to the U.S. practitioner considering the development of systems with both rail and bus services. This chapter examines the characteristics of the rail component of the total ground access strategies used in the 14 successful systems. The focus of the chapter is on the attributes of rail service that are associated with high mode shares to rail systems. The actual method by which these attributes can be achieved in the U.S. experience may be different from the methods used in Europe and Asia.

A REVIEW OF THE RAIL MARKET SHARES

The market share gained by rail service for the 14 successful services is presented in Table 5-1. The criterion for the selection, as reviewed in Chapter 4, was the role of the rail services in a public transportation system that attained more than a 20 percent share of the market. Reference was also made in Chapter 4 to systems for which there is not yet a market survey but whose overall share to public transportation will clearly meet the established criterion: the new rail systems at both the Copenhagen and Stockholm airports. As shown in Table 5-1, the ranking of the 14 rail services cannot be explained by measures as simple as the location or the size of the airport. Almost identical market shares are reported for the airport located closest to the downtown (Geneva) and located furthest from the downtown (Tokyo Narita). Nor can the size of the airport be used to forecast rail market share: the largest airports, Heathrow and Frankfurt International, are in the mid ranks in terms of ground access market share; the smaller airports rank both higher and lower than the largest. This chapter will examine the role of rail services of the 14 successful ground access systems in terms of four major elements of a total strategy, each of which can help to define the key "lessons learned" for the U.S. practitioner considering the implementation of a fixed guideway element of an airport ground access system.

FOUR ELEMENTS IN A SUCCESSFUL AIRPORT RAIL SYSTEM

This chapter will focus on the rail projects that form the principal mode of most of the successful systems described in Chapter 4 by describing the characteristics associated with the success of these rail projects. This chapter will explore the importance of four elements of a total strategy, drawing examples from the systems described in Chapter 4. These four elements are:

1. Service to downtown and the metropolitan area;
2. Service to national destinations beyond the metropolitan area;
3. Quality of the rail connection at the airport, or the airport–railway interface; and
4. Baggage-handling strategies and off-site facilities.

BASIC DEFINITIONS

Metropolitan Services versus National Services

The link from the airport to the downtown is just a part of a larger transportation system to move the user to his or her actual trip destination. This chapter examines the characteristics of service for (1) airport users with local destinations in the metropolitan area and (2) airport users with destinations beyond the metropolitan area. In the European experience, the longer-distance ground access trips tend to be accommodated by national rail systems and are referred to in this report as "national" services. In the U.S. experience, destinations beyond the metropolitan area might be referred to as "statewide" or "exurban" destinations.

For each of the two geographic service categories, two strategies of service are documented: dedicated and shared.

Dedicated versus Shared

Rail services to airports can be categorized as either a *dedicated* service or a *shared* service. With dedicated service, services and vehicles designed specifically for the needs of the airline passenger are provided. With shared service, airline passengers use the same vehicles as other public transportation

TABLE 5-1 Ranking of rail system performance

Rank in sample	City/airport	Rail mode share (percent)	Airport distance (miles)
1	Oslo	43	30
2	Narita	36	42
3	Geneva	35	3
4	Zurich	34	8
5	Munich	31	18
6	Frankfurt	27	6
7	Stansted	27	34
8	Amsterdam	25	9
9	Heathrow	25	15
10	Hong Kong	24	21
11	Gatwick	20	28
12	de Gaulle	20	15
13	Brussels	16	10
14	Orly	14	8

passengers in the corridor of service. In London, both the Gatwick Express and the Heathrow Express rail services are examples of dedicated service, with vehicles designed for the airline passenger. Service to Heathrow Airport on London Transport's Piccadilly Line and other commuter rail services stopping at Gatwick Airport are examples of shared service.

Many dedicated services market their high-quality line-haul times with fast service to only one terminal. Most shared services, such as the Piccadilly Line to Heathrow, provide relatively slow speeds into the city, but with distribution to many points in downtown. In many cases, the dedicated service (e.g., Gatwick Express, Heathrow Express) utilizes a vehicle designed to accommodate checked baggage. In most shared services, such as Munich's S-Bahn service, no specialized vehicle is used, resulting in vehicles that may not serve travelers' need for extra baggage space. Of the 14 ground access systems, 6 can be described as using a dedicated-service strategy. The other systems have chosen to provide service that is designed primarily for the commuters and the rest of the system. A characteristic of the dedicated-service strategy is the ability to provide minimized travel times between the airport and the downtown. However, the most successful overall mode share is gained by airports that offer a variety of strategies. Table 5-2 presents a categorization of the services offered at each airport.

ELEMENT 1: SERVICE TO DOWNTOWN AND THE METROPOLITAN AREA

In the case studies of successful rail services to downtown, two strategies for service design emerge: (1) focusing on the line speed to the terminal or on the quality of distribution services, and (2) minimizing the headway that comes from joint operation with regularly scheduled services. Both strategies seek to produce a door-to-door travel time that is competitive with the taxi and the private vehicle. In the comparison of the two strategies, the Oslo Airport Express can be used as a prototype of the high-speed, dedicated strategy; Munich's standard S-Bahn can be a prototype of the lower-speed, shared strategy. In the last year, service was improved in Oslo by decreasing the line time, while service in Munich was improved by doubling the number of trains, thus lowering the waiting time by 50 percent.

Dedicated Express Service to Downtown

Until recently, trains dedicated to the needs of airport users operated only to London Gatwick and Tokyo Narita Airports. In 1998 and 1999, there has been a significant expansion of the application of the dedicated train, with exclusive service to the downtown terminals. In these 2 years, new dedicated services opened in Hong Kong, Oslo, London (at Heathrow Airport), Milan, and Stockholm. In addition, new rolling stock, with new branding, is being introduced at London's Gatwick and Stansted Airports. During this period, plans for such dedicated express services were announced for Paris, Berlin, and Kuala Lumpur.

TABLE 5-2 Categorization of line-haul services

Airport	Rail mode share	Dedicated train		Shared train	
		CBD	National	CBD	National
Oslo	43	Yes	Yes	Yes	Yes
Tokyo Narita	36	Yes	Yes	Yes	No
Geneva	35	No	No	Yes	Yes
Zurich	34	No	No	Yes	Yes
Munich	31	No	No	Yes	No
Frankfurt	27	No	No	Yes	Yes
Amsterdam	27	No	No	Yes	Yes
London Heathrow	25	Yes	No	Yes	No
London Stansted	25	Yes	No	Yes	Yes
Hong Kong	24	Yes	No	Yes	No
London Gatwick	20	Yes	No	Yes	Yes
Paris de Gaulle	20	No	No	Yes	Yes
Brussels	16	No	No	Yes	Yes
Paris Orly	14	No	No	Yes	No

The Role of High-Speed, Dedicated Service: Oslo, Hong Kong, London Heathrow, and Milan Malpensa

Oslo Airport Express. The Oslo Airport Express train, which has the highest mode share to rail in the sample, can be used as an example of a strategy that is based on a determination to attain high running speeds and low terminal-to-terminal travel times. The train is shown in Figure 5-1.

The fast running speeds and short travel times were established as part of a larger political process of siting a new airport for Oslo. After several years of design activity at a different site, the Norwegian government selected an existing military airport at Gardermoen, located 30 mi north of Oslo. A political goal was established: the running time of the train to the new airport be no longer than the running time of the bus from the existing airport—19 min. Planners established the need for high speed by examining comparative total trip times (see Figure 5-2). A major financial commitment was then made to bring about these short travel times, with about Nkr 7 billion (US $900 million) spent on the airport–rail connection. Of this, about Nkr 5.6 billion (US $722 million) was for the infrastructure and Nkr 1.4 billion (US $180 million) for the rolling stock.

For this investment, the government set the following policy goal: the airport rail system would attract 50 percent of the market, a mode share considerably higher than any system had attained to date. Of this desired share, 42 percent was set as the goal for the Oslo Airport Express service, with an 8 percent goal established for the traditional national train service. With about 12 million nontransferring air passengers, some 6 million air passenger rail riders were forecast. In addition, a policy goal has been set to attract 40 percent of airport-based employees to the combined rail system. The original operating plans called for the operation of 200 Airport Express trains and 94 state railway trains using the new airport station each day. The high-speed strategy focused on the need to bypass a slow section of local track just east of Oslo and to construct a new 14-km (9-mi) tunnel. Construction problems with the tunnel, which are now resolved, delayed opening of this segment until 1999.

Figure 5-1. The Oslo Express train, an example of dedicated express service.
SOURCE: Adtranz.

In Oslo, the strategy to provide high-speed service to the downtown and additional direct service beyond has resulted in a 39 percent market share for the dedicated Airport Express train and another 13 percent mode share to the slower, lower-priced Norwegian Railway. The new tunnel segment has now opened, making possible the originally planned 19-min travel time to the downtown terminal, compared with the 33-min travel time during the temporary service. In addition, trains now operate every 10 min, compared with the earlier 15-min headway. Data will soon be available on any change in market share resulting from these two changes in trip characteristics.

The need for line-haul speed is reflected in the design of the new trainsets for the Oslo Airport Express. Because the dedicated trains are also used in service beyond the downtown, the trains were designed to meet the standards of the national intercity network. New high-speed trains, designed for 250-kph (155-mph) service, are now running at 210 kph (130 mph). Each train has 175 seats; two trains are coupled together for peak-hour service. The trains represent the state of the art, providing a "business-class" seating standard throughout; no separate first-class seating is offered. The strategy for baggage handling is discussed later in this chapter. One of the trainsets has been equipped with the tilting technology used on Sweden's highest-speed intercity trains (*41*).

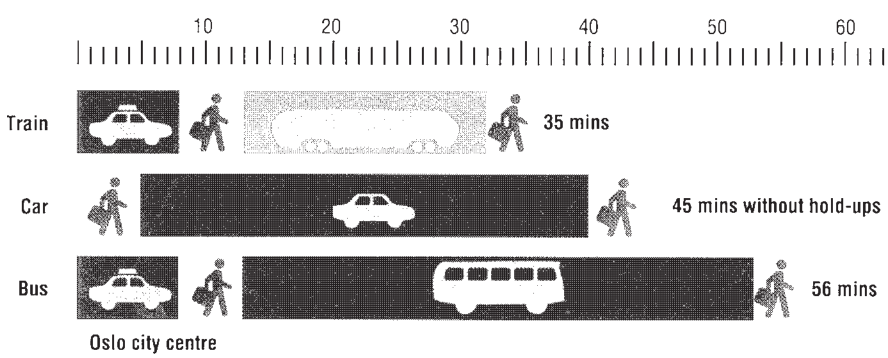

Figure 5-2. Door-to-door travel times were used planning the Oslo Airport Express.
SOURCE: Oslo Airport at Gardermoen.

Hong Kong Airport Express. The Hong Kong Airport Express Line (Figure 5-3) is one element of a larger plan to provide two categories of service on one rail infrastructure. A new commuter train for general-purpose use has been developed for Lantau Island, the location of the new Hong Kong Airport. The interior of the commuter train looks very similar to the high-volume service offered by MTRC throughout Hong Kong. All seating on the commuter train is on long, unupholstered bench seats, which are used by rapid transit systems around the world to maximize room for standees. Ticket pricing is consistent with the costs of other mass transit services in the area.

Superimposed on this infrastructure is an elaborate "skip stop" operation, in which the express trains are routed onto short bypass tracks at each of the local stations. Although the bypass tracks are in operation at the local stations, the fundamental infrastructure—particularly in expensive tunnel and bridge segments—is that of a two-track railroad. In effect, two complete systems must be dispatched simultaneously, resulting in a precisely managed rail operation. Little tolerance exists in either system for failure or delay in the other system.

The result of this skip stop operation is an imaginative marketing concept, in which two classes of service—aimed at two very different submarkets—are operated over a common infrastructure. The users of the local train never see the elaborate check-in stations in Central Station or Kowloon Station, because those users are routed into standard stations. The users of the Airport Express are, generally speaking, not aware that the same rail company is operating a second service to the airport complex at a fare one-third to one-quarter of what the Airport Express users are paying.

The creation of a high-speed service with a higher ticket price is the result of a marketing plan to provide a service with a high level of amenity for the airport user, while sharing infrastructure investment with the commuter system run by MTRC. The rail line to Lantau Island cost more than HK $34 billion (US $4.5 billion). The express service offers a 23-min travel time from the airport to the downtown.

Figure 5-3. The Hong Kong Airport Express.
SOURCE: Mass Transit Railway Corporation, Hong Kong.

Heathrow Express. The Heathrow Express, shown in Figure 5-4, was designed to provide a high-speed alternative to the existing rail transit service to Heathrow Airport. A political review in 1983 of the future of Heathrow determined the further growth of the airport should be contingent on the creation of a high-speed rail link. From Paddington Station, the existing intercity tracks are shared with other rail operators for 19 km (12 mi), at which point a new flyover leads to a new right-of-way, which tunnels into Heathrow's central terminal area. At this location, the front of the platform leads to escalators for Terminals 2 and 3, while the back of the platform connects to Terminal 1. A single-track tunnel continues on to Terminal 4, which has two platforms.

The express train project was built for £422 million (approximately US $675 million). Nonstop service is provided between Paddington Station and Heathrow's central terminal area, at an advertised time of 15 min.

Milan Malpensa Express. Service to Milan's Malpensa Airport is being phased in incrementally. When the airport opened in 1998, few ground access services were available by any mode. In 1999, the initial phase of the Malpensa Express was inaugurated with constrained service levels caused by a long, one-track segment. Service to downtown Milan, now offered every 30 min, will improve when the full double-tracked right-of-way is constructed. The major airline, Alitalia, operates one of the train cars and offers "flight" attendant service to those with Alitalia tickets (*42*).

Planned Services with the Dedicated-Express Concept: Berlin Brandenburg, Kuala Lumpur, and Charles de Gaulle

Berlin Brandenburg. In 1999, German Railways announced its decision to develop a dedicated train to operate

Figure 5-4. The Heathrow Express at Paddington Station.

express service to the new Berlin Brandenburg International Airport, which will consolidate and replace the existing airports in Berlin. An S-Bahn suburban rail line already serves the site for the new airport, currently called Schonefeld Airport, with a 25-min service to downtown.

The S-Bahn division of German Railways will develop a new dedicated express line that will connect with Berlin's new central rail station—called Berlin-Lehrter Bahnhof—with only two intermediate stations. The specially designed trains will be capable of 100-mph service and will reduce the running time to downtown to 18 min. Some dedicated trains will continue beyond the CBD to serve the suburb of Potsdam, to the west. Adtranz will build the trains, which will have all seats facing a baggage-storage area, as originally developed for the Oslo Airport Express train. As shown in Figure 5-5, the new German service will be branded as the "Airport Express."

Kuala Lumpur. In Malaysia, Kuala Lumpur trains will run every 15 min, making the 57-km (35-mi) service to downtown less than 30 min. Slower, cheaper commuter trains will also be operated along the line to downtown Kuala Lumpur. Called the Express Rail Link (ERL), it is a high-quality, high-amenity service, designed to appeal to air travelers. The proposed baggage strategy for the Kuala Lumpur system is the most ambitious in the world and will be discussed later in this chapter.

Charles de Gaulle. For years, the access strategy between Charles de Gaulle Airport and downtown Paris has been based on the use of standard regional rail services, which are shared with commuters. No use of specialized service to the downtown was planned.

Now, French National Railways (SNCF) and Aeroports de Paris are developing a new dedicated, high-speed service to a downtown terminal—either Gare du Nord, terminal of the Eurostar train from London, or the immediately adjacent Gare d'Est. Thus, Charles de Gaulle Airport will soon have two services available to the customer, at two separate price points. Reportedly, the new trains will be similar in marketing concept to the existing TGV, although the actual distances may not require true high speeds.

Figure 5-5. Concept design for the Berlin Airport Express train.
SOURCE: Adtranz.

Specialized Airport Access Design: Information to the Passenger

Many of the new dedicated trains incorporate innovative information systems to help the passenger on the airport trip. An early example of such information is the use of map graphics on the Narita Express, which show the traveler the location of the train on the map, the actual time, and the expected arrival time at the airport. At all times, the rail rider has a sense of orientation and is (presumably) reassured that the airport time connections can be met. In the Hong Kong Airport Express, an arcing space at the ceiling over the center aisle is used to show an electronic map that has the downtown on the left and the airport on the right. As the train proceeds through the journey, its location is shown on the electronic map.

The Hong Kong railcar is unique in its use of seat-back televisions for every rider, as shown in Figure 5-6. These television screens offer several channels of content, ranging from stock-market summaries, to airport information, to comic silent movies. At present, airline schedule information is provided; there are no plans to add real-time information about airline flights. The televisions are heavily used, and, according to an unscientific survey, most riders select the silent movies.

The Heathrow Express and Oslo Express vehicles both place standard television screens near the doors (Figure 5-7). The layout of the Oslo train allows the television to be placed in the storage bin located in the center of the aisle, a highly visible location for the television. Immediately before departure and arrival, the television displays information about the departure and arrival times. During the journey, the Heathrow Express presents the BBC world news. The content of the television program is sequenced by trackside radio beacons: for example, the message "We are about to arrive at Heathrow" is triggered when the train passes the appropriate point.

The Hong Kong system is based on silent images throughout; the Heathrow Express pipes the soundtrack of the television content throughout the vehicle. Users of cell phones compete with the sound of the television service. To deal

Photo: Matthew A. Coogan

Figure 5-6. Hong Kong Airport Express televisions are located on each seat back.

Photo: Matthew A. Coogan

Figure 5-7. Heathrow Express televisions are located near the doors.

Figure 5-8. The two Munich airport lines operate with standard S-Bahn trainsets.
SOURCE: Munich S-Bahn.

with the conflict, a "silent zone" is offered in both first-class and standard compartments, in which occupants are asked to refrain from using cell phones. (U.S. application of television systems for essential information may need to incorporate sound to comply with the Americans with Disabilities Act [ADA] regulations.)

Shared Local Service to Downtown

The Role of Low-Speed Shared Service: Munich

Although several cities have chosen to create dedicated, express airport services, most of the airports in the sample are served by rail lines, which are also used by daily commuters. Munich can be used as an example of a local strategy, because, as shown in Figure 5-8, the airport station is served only by conventional metropolitan railway equipment, with no direct national service. Recently, the Munich S-Bahn system made a major improvement to airport service with the addition of a second local rail line, making no change in the basic strategy to serve the airport with the existing metropolitan rail system.

In 1998, the Munich system doubled the amount of service to the airport, with standard local equipment providing service that is shared with the other users of the system. A new line has been extended for 7 km (4 mi) from an existing route, the S-1 (shown at the left end of the dotted line on Figure 5-9), at a cost of DM 220 million (US $121 million). In the first months of the new service, ridership from the airport station increased by 7 percent, with air passenger mode share rising from 28 to 31 percent. This increase in ridership is notable, in that the actual travel time by either of the two lines to downtown remains about 40 min, which is similar to that of the London Underground from Heathrow Airport but worse than that of most other local airport services.

The managers of the Munich S-Bahn system developed a highly innovative method of providing the extra service to the airport. Because there was no room in the schedule of the S-1 line for additional trains, the decision was made to serve two destinations with one line by splitting each train into two trains at Neufarm Station, as shown in Figure 5-9. The front cars of the train continue on to the airport, and the back cars of the train continue on the existing service to its terminal at Freising. In the opposite direction, the procedure takes about 4 min.

With the combined services of the two lines, the airport gets a combined 10-min headway, with no change of vehicle service to 9 downtown stations and immediate connections to 10 local rail lines and the national rail system at the central station.

The choice of shared service has led to problems. Initially, the airport opened with a check-in center located at the central railroad station. However, there was no way for the standard commuter equipment to accommodate the baggage because space onboard was needed for use by passengers. The baggage was placed on the airport bus, which operates to the central rail station. However, the downtown baggage check-in service was abandoned for lack of use.

Characteristics of Low-Speed Shared Service: Interconnections with the Local System

The provision of airport services shared with the local rail system has the potential of providing multiple points of transfer with other elements of the metropolitan system. Although the multiple stops associated with most local rail services provides for slower line-haul speeds, these stops allow for more points of interconnection than are provided by an express service to one or two terminal locations.

Between Munich Airport and Hauptbahnhof Station (the central station), there are 13 intermediate stations, making connections with 14 separate connecting rail lines (see Figure 5-8). Planners estimate that 80 percent of S-Bahn users take a second train to get to their destination.

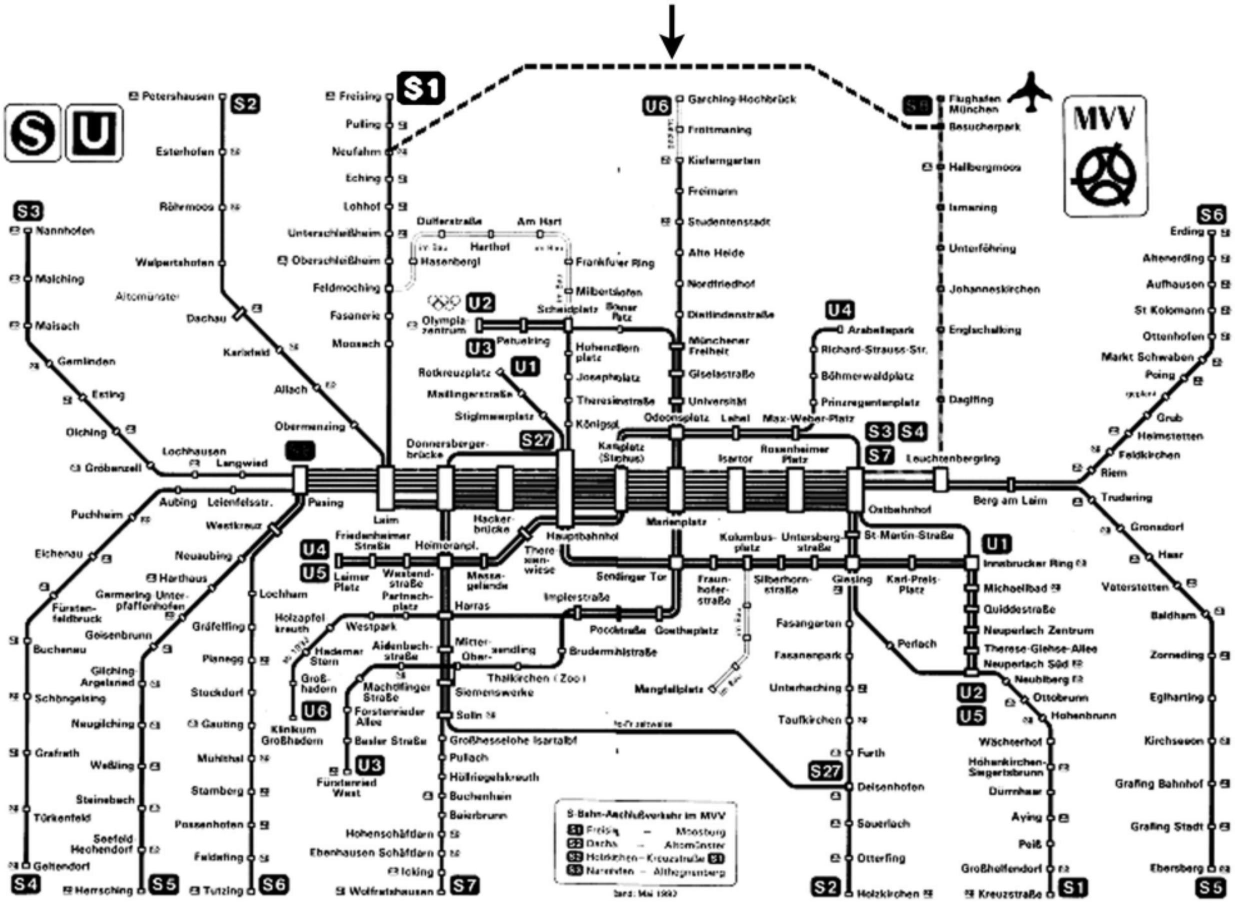

Figure 5-9. The dotted line shows the extension of a branch of the S-1 line (left) to the S-8 line (right) at the Munich airport.

SOURCE: Diagram adapted from MVV brochure.

Between Heathrow Airport and Kings Cross Station, the London Underground's Piccadilly Line has 23 stations and connections to 12 separate routes. Thus, service is available to virtually all of central London with only one rail transfer, as shown in Figure 5-10. The Piccadilly Line of London Transport uses standard rapid transit rolling stock, with low-speed operation, and captures about 14 percent of the market from Heathrow Airport. See Figure 5-11.

Germany and France have developed a hybrid metropolitan transit train that incorporates the higher speeds of commuter rail with the downtown distribution characteristics of rapid transit systems. Both the Frankfurt S-Bahn and the Paris RER (electrified suburban rail network) (Figure 5-12) systems are designed to maximize the quality of transfer through the rest of the system. The Frankfurt system captures about 21 percent of the market; the Paris RER captures 16 percent of the Charles de Gaulle Airport market.

The primary market for all these shared local services, however, is not the airport user, and the systems tend to operate at capacity during rush hours. Finding room for baggage becomes an annoyance to the air traveler and to the commuter alike. The physical design of many commuter transfer stations does not accommodate the needs of travelers who have baggage.

Lessons Learned: Successful Systems to Downtown

Express Service versus Multistop Service: The Role of Distribution

In each of these examples, the line-haul travel speeds from the airport to the center city are slow, but the service is well integrated with local distribution systems. In each of these airports, the local rail service, with its shared services, captures more of the market than does any other service.

An example can be observed in London: service on the Heathrow Express takes about 17 min to Paddington Station, leaving every 15 min. Piccadilly Line service to downtown takes about 40 min, leaving every 4 min. The express train user waits an average of 7.5 min and travels 17 min, for a total travel time to Paddington Station of about 25 min. The walk

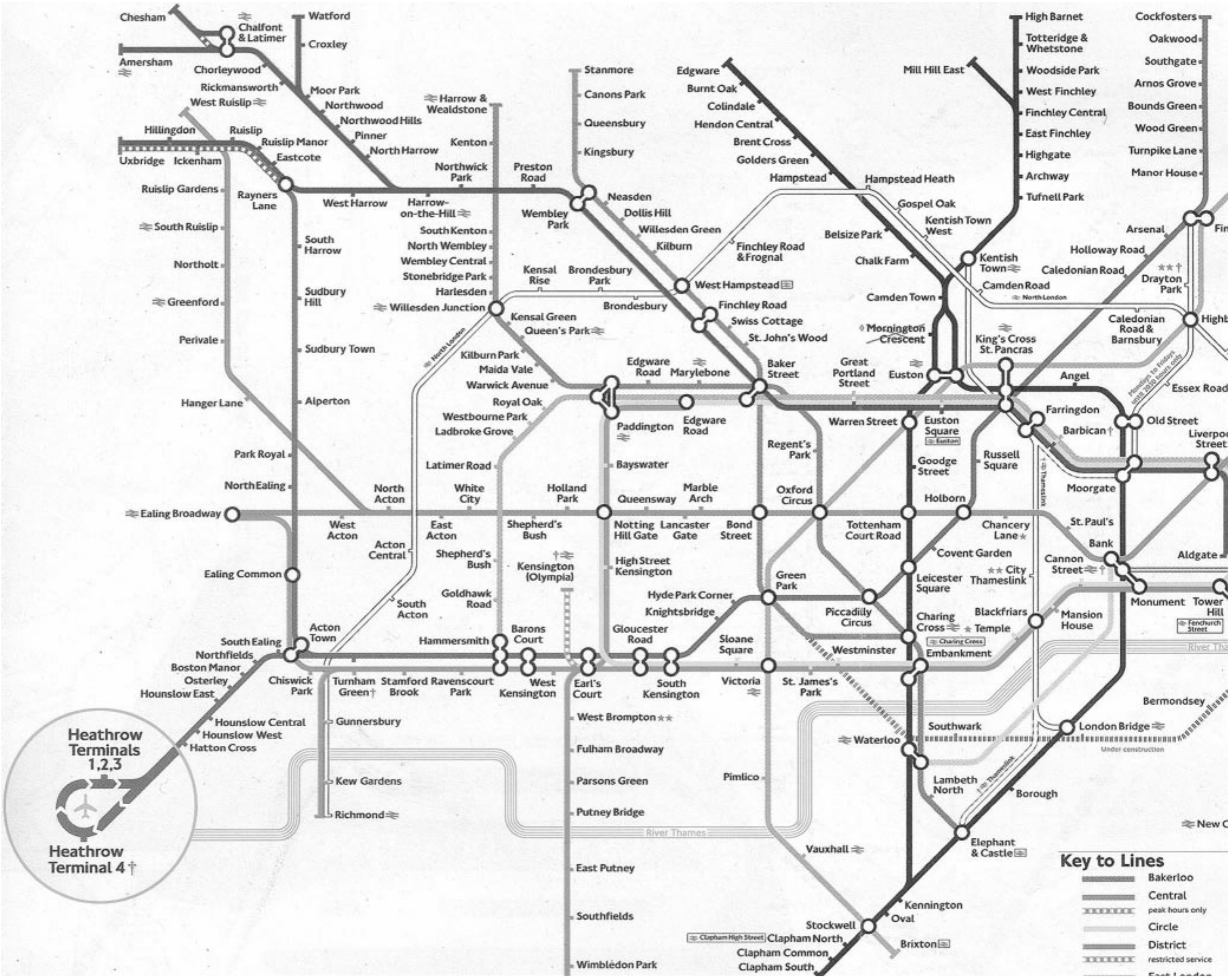

Figure 5-10. The Piccadilly Line from Heathrow Airport offers direct connections to most of London's rapid transit system.
SOURCE: London Transport.

Photo: Matthew A. Coogan

Figure 5-11. The London Underground is poorly configured for passengers with baggage.

Photo: Matthew A. Coogan

Figure 5-12. The rail station at Charles de Gaulle Airport is served by the RER System.

from the express rail platform, through the Paddington station complex, to the specific underground platform takes about 7 min. The headway of the connecting service may add another 5 min of waiting time. Examination of total trip times shows that there are only a small number of Underground stations (the immediately adjacent stations on lines connecting from Paddington) at which the total travel times for the Heathrow Express plus Underground are superior to the Underground plus Underground travel times. (This analysis is based on unweighted transfer times; it is customary in the analysis of transit times to weight the time spent waiting for a vehicle as at least two times that of the time spent on the moving vehicle. With such an assumption, the 4-min headway of the slower train results in a perceived travel time to downtown that is competitive with that of the faster train with the 15-min headway.

Two markets are revealed: when the journey is to be completed by taxi, the benefits of the express train to one terminal are obvious; when the journey is to be completed by local transit, much of the travel time superiority is lost when the user has to make the transfer onto the local transit system.

Even with significant differences in line-haul times, for many air passengers the modal decision may be less driven by in-vehicle travel times than by the convenience of the trip. Shared services make the air traveler endure whatever level of overcrowding exists on the rail vehicle during rush hour, which, in London, can be a serious problem. Dedicated services provide guaranteed quality of service on the line-haul segment, leaving the user with the need to find adequate distribution from the rail terminal.

The Emergence of New Services: Fast Line Haul, Good Distribution

Officials at BAA, which owns the Heathrow Express, are now developing service concepts that address the problem of integration into the rest of the transportation system. Within the next 3 years, another Heathrow Express service will be added to St. Pancras Station, with stops at intermediate stations to the north and west of London, as shown in Figure 5-13. In this service concept, Heathrow Express service to both Paddington Station and St. Pancras Station would be offered every 15 min. A rider simply seeking the first line haul into the downtown system would have service available every 7.5 min.

As an interim step to this improvement in distribution quality for the Heathrow Express, a new express service to Paddington Station that stops at intermediate rail stations will soon be inaugurated. Stops at these transfer stations will allow

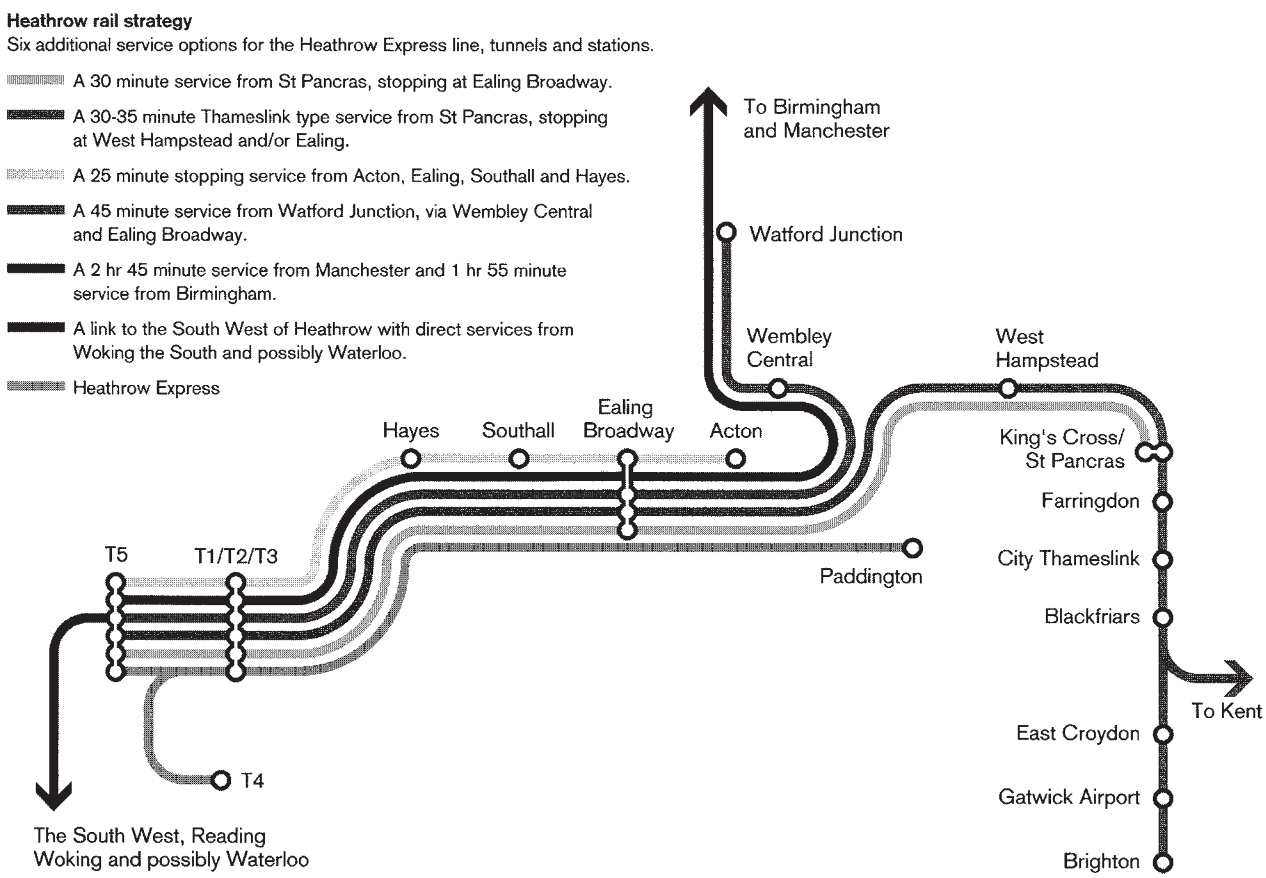

Figure 5-13. In the future, the Heathrow Express will be integrated into the suburban rail network.
SOURCE: BAA (formerly British Airports Authority), Heathrow Airport Transportation Policy—Factfile, internal document, 1997.

rail passengers arriving from the west to intercept the Heathrow Express trains earlier and to reduce their travel times. One of these stations—Ealing Broadway Station (see Figure 5-13)—will provide transfer to the London Underground rapid transit lines, creating more options for distribution throughout the network.

A Case Study: Fast Service versus Slower, More Direct Service

Planners at the Hong Kong MTRC have been examining the competitive market position of the fast rail and the slower bus services available to the air passenger. High-quality, air-conditioned buses, which are often double-decked (see Figure 5-14), provide direct service to many urban destinations.

Looking only at travel from the airport to downtown (Central Station), the fast train provides service in 23 min, at HK $70 (US $9.05). The Airbus A route takes 48 min and charges HK $40 (US $5.15), while the standard city bus takes 53 min and charges HK $21 (US $2.70). The rail gained 21 percent of the market, the airbus took 16 percent, and the city bus took 20 percent.

The factors that result in this high mode share to bus seem to include more than price minimization, because MTRC provides good lower-priced service to the airport complex. From the beginning, planners designed the rail system to operate with two price points. While the Airport Express Line train to downtown operates directly from the passenger terminal for HK $70 (US $9.05), a second train, reachable by shuttle bus, operates from a nearby station. The entire trip (shuttle plus train) on the standard train costs only HK $23 (US $3), which is directly comparable with the cost of the city buses. In fact, the user of this connection can get to Central Station in only 39 min, compared with 53 min on the city bus. But for this price-sensitive market, the shuttle bus-to-rail connection is capturing only 3 percent of air passengers; the direct city bus captures 20 percent. The bus system serves many area destinations directly, with no change of mode required for the trip. For the air traveler, directness of service may be more important than price minimization or line-haul speed to the terminal point (*43*).

Photo: Matthew A. Coogan

Figure 5-14. Hong Kong International Airport is served by buses offering direct services to many local destinations.

In order to understand the motivation for mode choice—and to explore the attribute of directness of service—MTRC managers undertook some market research. Of those riders on the direct bus routes, an expected 55 percent said that the lower fare was a reason for choosing the bus; importantly, 51 percent stated that directness of service (i.e., no need to transfer) was a reason for their choice of mode. Directness of service was considered a factor by only 18 percent of rail riders, presumably those with destinations convenient to the terminals.

Of those riders on the Airport Express, an expected 63 percent stated that speed was the reason for choosing the rail. Some 13 percent of the rail users mentioned the fare as the reason, which is lower than the fare for either taxi or airport door-to-door bus service.

In an important conclusion, one of the original architects of the Hong Kong Airport Express writes:

> "It is apparent that even with a good design and well-integrated railway service, the Airport Express does not have inherent advantages over more direct single mode bus travel. In other words, the speed advantage of rail versus single mode road competitors when traveling over distances of only up to 34 km [21 mi] do not result in significant enough time savings to compensate for the necessary transfer." (*44*)

Lessons Learned: The Importance of Line-Haul Speed

Comparative Line-Haul Travel Times

The examination of relative line-haul speeds in the database of successful international airport rail operations has several key implications for the U.S. practitioner.

The first implication, and by far the most important, is the difference that exists in the basic travel-time conditions, largely associated with the existence of fast highway connections in the United States. Four of the airports in the sample offer service to downtown that is twice as fast as automobile service. Table 5-3 shows that automobile travel times in Oslo are two-and-a-half times as long as the rail line-haul time. Table 5-3 shows many examples in which the automobile travel times are significantly higher than the rail travel times. Given the extent of roadway investment in the United States, attaining similar relative travel- time advantages for rail services will be difficult in most U.S. applications.

The second implication is that the rankings of services by relative travel times to downtown do not correlate linearly with the rankings by mode share performance. The data reveal that

TABLE 5-3 Comparisons of line-haul time, by modes and distance

Rank in sample	City / airport	Rail mode share: percent	Car time to CBD: minutes	Rail time to CBD: minutes	Ratio	Airport distance: miles
1	Oslo	43	50	19	2.6	30
2	Narita	36	90	55	1.6	42
3	Geneva	35	10	10	1.0	3
4	Zurich	34	20	10	2.0	8
5	Munich	31	35	40	1.1	18
6	Frankfurt	27	20	12	1.7	6
7	Stansted	27	70	40	1.7	34
8	Amsterdam	25	30	17	1.8	9
9	Heathrow	25				15
	Heathrow Express	11	45	15	3.0	15
	Piccadilly Line	14	45	45	1.0	15
10	Hong Kong	24	35	23	1.5	21
11	Gatwick	20	80	30	2.7	28
12	de Gaulle	20	45	35	1.3	15
13	Brussels	16	20	14	1.4	10
14	Orly	14	25	35	0.7	8

it is the comparative travel time on a door-to-door basis that seems to influence choice. The data presented in Table 5-3 show that the focus on travel time to one point may be unproductive. There are many points in central London where the slower mode (i.e., the Underground) gets the traveler to the destination without the negative experience of the transfer. There are many points in Hong Kong where the slower mode (i.e., the direct bus) serves the traveler more directly than the faster mode.

The third implication is that the travel-time characteristics to downtown may not be a good surrogate for the travel-time characteristics to the actual destinations of the users. The travel time to downtown Geneva is an interesting piece of information, but 75 percent of those leaving the Geneva Airport are not going to the city of Geneva. The ratios of comparative travel times to Lausanne or to Bern are considerably more favorable to rail. The service must be designed based on the understanding of the needs of the users and must reflect the actual spatial distribution of trip-end destinations.

ELEMENT 2: SERVICE TO NATIONAL DESTINATIONS BEYOND THE METROPOLITAN AREA

In 1980 in Zurich, the Swiss National Railways implemented the first airport–rail connection designed to link to a full national network rather than to just the immediate downtown and surrounding area. Before this time, other early rail lines, such as that serving Brussels Airport, were basically stub-ended terminals of local suburban railways. Even the most advanced connection—British Rail to Gatwick Airport—was marketed primarily to downtown London. But the Swiss system was marketed as a direct path to all major national destinations.

Twenty years later, airports throughout Europe are connected to national systems. Overwhelmingly, these national connections are not provided by specialized dedicated services but feature integration with traditional national rail services. However, a few examples of dedicated services for areas beyond the downtown have been operated and are summarized below. These services include the early efforts by Lufthansa to provide national rail service exclusively for air passengers.

Dedicated National Service

Lufthansa Airport Express

The earliest example of the use of specially built equipment for national intercity connections was the Lufthansa Airport Express (Figure 5-15), which started service between Frankfurt and Düsseldorf International Airports in March 1982. In 1990, service was inaugurated to Stuttgart. Significantly, the dedicated service was replaced with a shared-rail

Figure 5-15. The Lufthansa Airport Express was an early example of a dedicated service to national destinations.
SOURCE: German Railways.

service, which accommodated air passengers on regularly scheduled national trains.

Between 1982 and 1990, ridership on the line to Cologne grew from 62,000 passengers to 216,000. However, an examination of the markets for which there was also air service (to either Cologne/Bonn or Düsseldorf Airports) reveals that more than 600,000 passengers per year chose the plane and 200,000 passengers per year chose the train. It is estimated that the dedicated train captured 28 percent of the airline market to Bonn, 37 percent of the market to Cologne, and 35 percent of the market to Düsseldorf (*45*).

On the line from Cologne, baggage check-in occurred on the train, with agents accepting bags at the traveler's seat. On the line from Stuttgart, check-in occurred at the train station. Airline through-tickets were available for train stations in Düsseldorf, Cologne, Bonn, and Stuttgart.

By the mid-1990s, the Lufthansa Airport Express was operating in competition with many national rail services. Lufthansa Express operated only 4 trains per day toward Cologne; the national system operated 21 trains per day in the same corridor. The net result was that a ticket holder on the dedicated Lufthansa Express might wait on the platform, watching numerous fast trains go to his or her exact destination.

With the introduction of 185-mph ICE trains on four routes out of Frankfurt Airport, it became clear that utilizing the national rail network made more sense than continuing operation of specialized trains just for airport passengers. Lufthansa abandoned the separate train service and began a program to reserve certain seats on the standard national rail train.

Narita Express

JR East Railway's Narita Express operates dedicated airport rail service to six additional destinations beyond the CBD. However, most passengers use only the segment from Tokyo's Central Station to the Narita airport (see Figure 5-16). In general, connections between Tokyo Narita Airport and the national rail destinations are made by transferring at Central Station.

Figure 5-16. The Narita Express offers dedicated airport rail services to six stations beyond the CBD.
SOURCE: JR East website (www.jreast.co.jp/nex/index.htm).

Oslo Airport Express

Although most dedicated services do not go beyond the primary metropolitan area, the Oslo Airport Express is designed to provide specialized airport-oriented rail equipment on longer-distance connections. Of the six trains per hour that serve Oslo's Central Station, three continue toward the south and west.

Summary

In general, rail services from airports to destinations beyond the primary downtown area are provided by the national intercity rail network and are not dedicated to the air passenger. The case of the Lufthansa Airport Express demonstrates the difficulty of providing such services to a limited market over long distances. However, the success of the Oslo Airport Express, which is offered to several cities, is an example of the use of dedicated equipment to serve markets beyond the CBD.

Shared National Service

Integration with the National Rail System: Copenhagen

In Switzerland, the Netherlands, and Denmark, there are good examples of the integration of airports into national rail networks. A good example of national integration was the opening in 1998 of national rail services to a new station at Copenhagen Airport. The rail station at the airport is expected to attract about 4 million passengers in 2000 and 5 million by 2005. It is forecast that 1.4 million passengers from Sweden will use the new cross-sound rail service to the Copenhagen airport (*46*).

Swedish air passengers will access Copenhagen Airport over a new 18-mi bridge-and-tunnel connection between Denmark and Sweden (depicted in Figure 5-17). The combined highway-and-rail connection will cost about Skr 34 billion (US $4 billion). The new rail trains for the binational service will cost Skr 2.3 billion (US $270 million). Service across the channel to Sweden will operate every 20 min.

A proposed timetable from Copenhagen Airport shows six trains per hour departing for Danish destinations and four trains per hour departing for Swedish destinations. Seven trains a day would proceed to Stockholm, and five trains a day would connect the Danish airport with Gothenburg. It is calculated that a train will either arrive or leave every 4 min in rush-hour service. The combined departures will make the airport rail station one of the busiest in the world.

The air passenger boarding a train at Copenhagen Airport will be able to purchase an integrated public transportation ticket, covering all public modes needed to reach his or her destination. A single tariff system has been designed, which has 7 fare zones on the Danish side and 10 fare zones on the

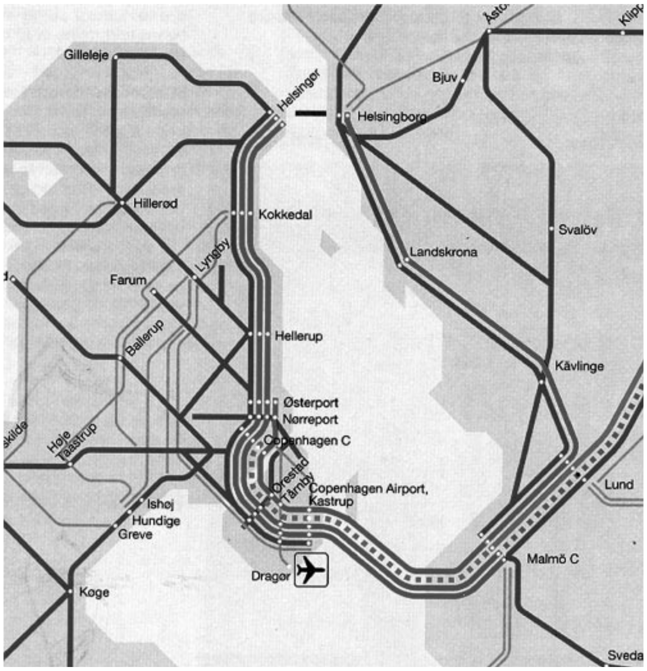

Figure 5-17. Copenhagen Airport is served by a new national and international rail system.

SOURCE: *We Are Linking the Øresund Region Together: A Fixed Link to the Future: Trains and Buses in an Integrated Public Transport Network with a Single Tariff and Ticket System.* Danish State Railways, Statens Järnvägar, and Hovedstadens Trafikselkab, Copenhagen, 1977.

Swedish side of the sound, that serves all combinations of bus and rail travel within the newly united region. Through fares will be designed so that the integrated ticket will always be cheaper than the sum of the separate tickets. The associated companies are spending Skr 0.5 billion (US $61 million) to bring about the integrated fare collection system (*47*).

Rejection of Dedicated Service for Air Passengers

Although dedicated express airport services are being developed in many areas around the world, managers of the Danish and Swedish rail systems are taking the opposite approach. No attempt is being made to offer separate services to air passengers. Rather, the Danish rail system serving the airport is being restructured to offer passengers the kind of amenities associated with a dedicated express concept. Most European railways offer two classes of service; Danish Railway has offered a third—"super first class." Called "Business Plus," the service includes a meal and often a compartment containing business equipment. In a highly unusual marketing scheme, Danish Railway charges a fixed price without regard to the distance of the trip.

Danish rail officials are now implementing a program of joint ticketing in which the price of the rail journey is included in the airline ticket. A pricing system based on four zones is being used for the unified air–rail ticket. This new kind of ticket will supplement the existing national program of integrated rail and bus tickets. The ground access system serving Copenhagen Airport provides a good case study for the integration of air and rail services, because at all times it serves the air passenger with services primarily designed for the national intercity market.

National Systems: Standard Speed Intercity Rail

Switzerland. The connection of the Zurich airport to the Swiss National Railway system in 1980 has resulted in significant passenger growth for the airport rail service. Between 1981 and 1989, rail traffic from the airport grew by 74 percent, while air traffic as a whole (including connecting airline passengers) increased by 67 percent (*48*). In 1987, Geneva Airport opened its rail station to complete the system.

It is estimated that 33 percent of Zurich Airport air passengers using the rail system come from the city of Zurich and another 8 percent come from the rest of the metropolitan area. Thus, some 59 percent are coming from outside the metropolitan area. For Geneva, only about 25 percent of the air passengers using the rail come from the city of Geneva, and 75 percent come from the rest of Switzerland and from France (*49*).

Currently, the Zurich airport is served by more than 170 trains per day, and the Geneva airport is served by 130 trains per day. Service is provided every hour on the main east–west line linking Zurich and Geneva.

Amsterdam. Like both Zurich and Geneva, the rail station at Amsterdam's Schiphol Airport is located on the national east–west trunk line and has direct service to most of the Netherlands. The airport is served by 550 trains per day.

Oslo. In addition to the operation of dedicated service to three corridors, Oslo Airport is served by traditional Norwegian State Railways services, as part of a national program to upgrade the railways' intercity network to the standard of 125-mph service. Figure 5-18 shows the travel-time difference that the national upgrading program will provide to the users of the new airport—as much as 50 min of travel-time savings.

National Systems: High-Speed Rail

France and Germany have established airport access concepts that are fundamentally different from those adopted in most other airport access systems; both countries are building new, dedicated rights-of-way for high-speed rail into their largest national airports. Amsterdam's Schiphol Airport is served by the Thaylis trains, which currently achieve 180-mph service only between Brussels and Paris.

Germany. Germany is now building rail infrastructure, which will take the new ICE train directly to airports in

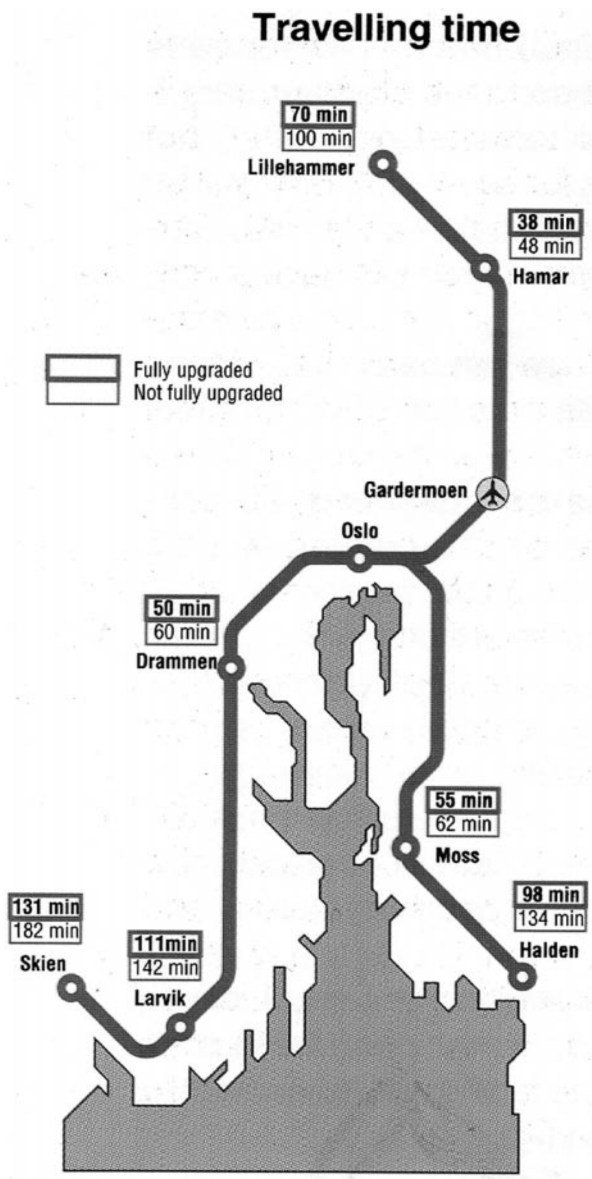

Figure 5-18. Norway is improving its intercity rail travel times to serve the new airport.
SOURCE: Norwegian Railways.

Frankfurt, Cologne/Bonn, and Leipzig/Halle and to a new AirRail station connected to the Düsseldorf Airport via a people mover. The first of these stations designed specifically for high-speed rail services opened in 1999 at the Frankfurt airport. The Frankfurt investment is the cornerstone of a national policy to expand Frankfurt Airport (and implicitly the role of the national airline) for international traffic.

Frankfurt Airport is developing an ambitious program to replace short-distance airline feeder services with improved rail connections. Only a limited number of slots are available for use at the Frankfurt airport; airport officials believe that the overall productivity of the airport can be increased by reallocating these slots for longer-distance flights.

The long-term plans for the expansion of Frankfurt Airport call for an increasingly important role for high-speed rail. In 1991, fewer than 10 percent of air travelers used the various national services, with about 19 percent using the local S-Bahn metropolitan railway. By 2010, airport forecasts call for 28 percent of air travelers to access the airport by the national railway and 15 percent by local railway. Thus, the goals of the airport call for nearly a three-fold increase of the present role for intercity rail to destinations beyond the metropolitan area.

France. SNCF is investing heavily in a new rail system to serve Charles de Gaulle Airport. A new circumferential rail line has been built bypassing Paris, allowing trains from the north (from Lille, London, or Brussels) direct service to the south (such as to Lyons and Nice). The new TGV service promises a travel time from Charles de Gaulle Airport to Brussels of 1.5 hr and to Lyons of 2 hr. Ultimately, full implementation of the high-speed rail service in England would allow for a 3-hr travel time to London. At the present, the market for these services is building slowly, with about 3 percent of airport passengers using the TGV services.

Extension of the French–British "Eurostar" Chunnel train to Heathrow Airport is under preliminary discussion.

Lessons Learned: Integration with the National System

In the examples above, whether the integration is with high-speed technology (France and Germany) or intercity rail service (Denmark, Switzerland, and the Netherlands), the airport strategy takes advantage of a capital investment decision already made for the rest of the national network. It is important to emphasize the scale of the national rail networks into which the airports have been integrated, because the lack of such rail networks in the United States will make similar strategies infeasible at most U.S. airports.

The travel times from the four high-speed lines serving the new Frankfurt Airport ICE station will provide service that is actually competitive with the short-distance air trips that airport officials are trying to discourage. A 1-hr travel time from Frankfurt Airport to downtown Bonn is directly competitive with, and probably better than, the same trip by commuter aircraft. The traveler in western parts of Belgium may be induced to make an international trip through Charles de Gaulle Airport rather than through the Brussels airport, because of the rail travel times created by the TGV.

Whether the rider chooses a service with a fast line-haul journey with very few stops or a service with a slow line-haul journey with many points for transfer, the subject of distribution to the final destination needs to be addressed. While the top speed of the train is always of interest, it is the overall travel time of the entire journey that the customer considers in choosing a travel mode. The designers of the system serving Copenhagen Airport have set a precedent for future systems integrating airport rail services into a national system whose overall quality is designed to meet the needs of the business traveler so often sought by the airlines.

ELEMENT 3: THE IMPORTANCE OF THE RAIL CONNECTION AT THE AIRPORT

This chapter reviews the importance of the quality of service provided by the train, the quality of the experience of boarding the train, and the quality of the experience of connecting to the rest of the transportation system in order to reach a final destination. For the potential rail customer arriving at an airport, key issues are the ease of locating the rail platform and the seamlessness of the connection to that rail platform. The creation of a high-quality, intermodal transfer facility often requires a high degree of cooperation between the airport designer and the rail system designer. To clarify the nature of the task of designing the transfer between rail and air, this section is presented in two parts: first, the task of designing a rail transfer facility at a new airport is reviewed; second, the issues of designing a rail transfer facility for an existing airport are reviewed. In each part, the difficulty of providing direct rail access is related to the configuration of the airport's passenger terminals.

Rail Connections at New Airports

Hong Kong

Few designers get the opportunity to plan an optimal intermodal system—a system characterized by the simultaneous design of the airport and the ground access services and viewed as one larger system. New airports have been built from the ground up in Paris, Dallas/Fort Worth, and Denver without achieving the integration of aviation and rail systems. Paris' Charles de Gaulle Airport was originally designed as a highly decentralized airport, with rail service to a town center but not to any of the terminals. By contrast, in both Oslo Airport and Hong Kong Airport, the designers were given the task of optimizing the relationship between the air and rail facilities. Hong Kong's airport can be viewed as one of the most aggressive attempts to date to integrate the rail station with the airport terminal structure.

Terminal Concept. From its earliest conceptualization in the Hong Kong airport master plan, the rail station was designed as a two-story structure (see Figure 5-19). For the enplaning cycle, the arriving train platform is located at the check-in level; for the deplaning cycle, the departing train platform is located at the baggage-claim level. The passenger is provided a free baggage cart from the baggage-claim carousel to the door of the train and does not change levels or experience any fare collection equipment.

Photo: Matthew A. Coogan

Figure 5-19. In Hong Kong, enplaning passengers connect from the rail on the upper bridge, while deplaning passengers connect to rail on the lower bridge.

The passenger flows in the air terminal have been designed to distribute passengers evenly over the cars of the train. Although the air terminal is more than 1,000 ft in length, the rail platform has been configured to be parallel to (as opposed to perpendicular to) the length of the airport. On the deplaning level, the airport passenger exits either at the northern arrival hall or at the southern arrival hall several hundred feet away. For each half of the airport, there is a simple, direct path to the train. Those passengers from the southern arrival hall are directed to the southern segment of the train, those from the northern arrival hall to the northern segment—this arrangement evenly distributes passengers through the length of the train. This pattern of locating the long, linear rail platform of the train parallel to the linear form of the air terminal was first applied in the Frankfurt airport, which has three points of access to the platform. The rail platforms at most airports, such as in Oslo and Munich, are configured perpendicular to the terminal; with just one point of access, passengers tend to "bunch" onto the nearest cars.

Having all the trains leave from one terminal station has certain operating advantages. Like the Gatwick Express, the Hong Kong station is operated so that there is always a train waiting at the platform. From the moment the passenger enters the rail station platform, he or she may start selecting a seat, stowing baggage, and so forth. Large electronic signs state exactly how many minutes remain before the departure of the train. In general, the task of providing simple graphic directions to the passenger is easier when there is only one rail station.

The Seamless Connection. MTRC has succeeded in making the path from the baggage claim to the train as seamless as possible. Personnel representing the Airport Express Line are located at the doorway between the customs clearance hall and the arrivals hall. Ticket booths and automated machines are located in the arrivals hall on the path from customs clearance to the rail platform.

The airport rail station has been designed without any fare collection equipment, even though entrance to every other station in the rail transit system requires that a ticket be inserted into a turnstile. The passenger merely uses the ticket to get out of the station when he or she has reached his or her destination. Every passenger is expected to have a ticket, but there is a fail-safe procedure in the event that a passenger does not have a ticket. Any passenger approaching the outbound turnstiles at the destination station without a ticket is forced to pay the highest fare on the system, which is the fare to the airport. Staff at all stations are trained to be polite to anyone who looks like an airline passenger and to arrange for a ticket sale at that point. Thus, there are no impediments between the arrival hall and boarding the train. The on-board staff members do not sell tickets.

Just before the arrival of the trains from downtown, the staff of the Airport Express distribute empty baggage carts along the length of the platform. Thus, when the doors of the train open, the rider sees a supply of available, free baggage carts immediately on his or her path into the air terminal.

Dealing with Expansion. The air terminal serving the first 40 gates of the Hong Kong airport is located immediately to the east of the two-level rail station. When the number of airport gates has more than doubled, a second air terminal will be built immediately to the west of the rail station. When the airport is fully built out, the walking distance from the train, through the check-in, and down to the underground people mover will be the same for both terminals. Thus, all 100 gates of the ultimate build-out will be served by a single rail station.

Oslo

In terms of an architectural concept for an airport–rail connection, the layout of Oslo's airport is more traditional, with the rail platforms located immediately below the arrivals hall. Figure 5-20 shows the walk from the arrival hall (labeled②) to escalators and elevators (labeled①) that serve the train platforms immediately below. All trains depart from these platforms, including the dedicated Oslo Airport Express, the

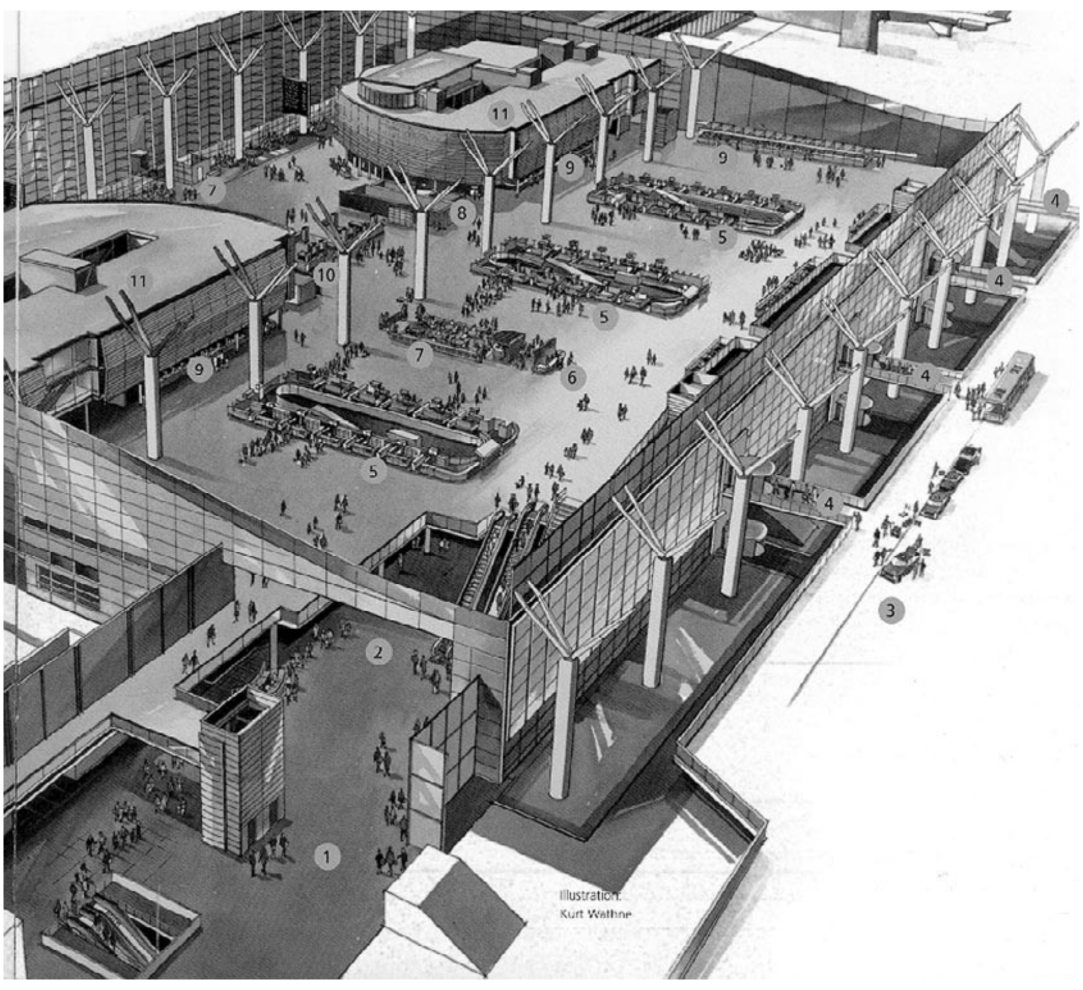

Figure 5-20. Escalators and elevators connect the arrival hall to the trains below.
SOURCE: Oslo Airport at Gardermoen.

national intercity rail, and local trains. The direct distance between the arrival hall and the rail platform is actually shorter at the Oslo airport than in the Hong Kong airport. However, in terms of ease of access, each change of level is a matter of some concern to those passengers with baggage, whether they have a baggage trolley or not. Similar "basement" locations at a centralized terminal are used in most European air rail stations.

The layout for the rail station is highly unusual, making the connection to the train as seamless and unencumbered as possible. The four tracks are laid out so that the passenger waiting for a departing Oslo Express train waits only on one center platform, which is served by two tracks. In a layout used in most airport people-mover shuttle configurations, each of the two arriving trains is also served by a separate outside platform. In this configuration, the arriving train always opens the outer doors first, sending the exiting passengers onto the exterior platforms; then the inner doors are opened for the new passengers to board the empty train. Although this is a common design for people movers, most rail station designs allow only one platform per track. The flow from terminal arrival hall to departing train is accomplished with absolutely minimized interference, with the luxury of providing separate graphic content for enplaning and deplaning passengers.

The expansion plan for Oslo Airport calls for the creation of a new midfield concourse, which will be served by the existing landside terminal.

New Airports with Difficult Connections: Charles de Gaulle

Not all airports that are built from a "green field" have easy connections for major rail investment. The original concept for Charles de Gaulle Airport proposed a series of terminals, architecturally modeled after Terminal 1, located in a highly decentralized format around a town center, where the original rail station is located. A people-mover loop would have connected as many as eight of these unit terminals. In the 1990s, a new vision was developed: Terminal 2 is directly adjacent to the new rail terminal, which provides service to both local and national lines. As shown in Figure 5-21, the long-term plan of the airport calls for the construction of two separate people movers: one to connect the new rail center with the original Terminal 1, and a second to connect the new rail center to the new boarding areas within Terminal 2.

Although the ultimate introduction of the automated people mover will help the transfer process from Terminal 1 to the TGV rail station, the connection is highly indirect, giving a distinct travel advantage to travelers using automobiles.

Adding the Rail Station to Older Airports

Retrofitting an Existing Airport: Zurich

Most public transportation planners, whether within or outside the United States, do not get the luxury of starting from a clean slate with the simultaneous implementation of a new airport and a new transit line. In most cases, the design challenge is to take a rail line into an airport that is largely developed, which is a different challenge than that experienced in Oslo or Hong Kong. The airport rail station in Zurich can be used as an example, as it was built into a working airport and is now being rebuilt to provide higher standards for the rail user. The rail alignment on the upper right of Figure 5-22 shows how the

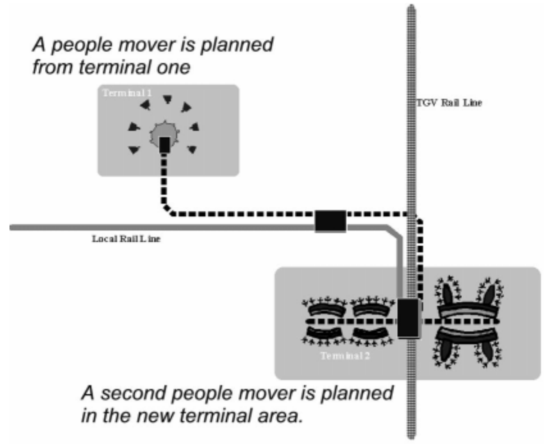

Figure 5-21. Two separate people-mover systems will be required to connect the Charles de Gaulle air terminals with the primary airport rail station.
SOURCE: Matthew A. Coogan.

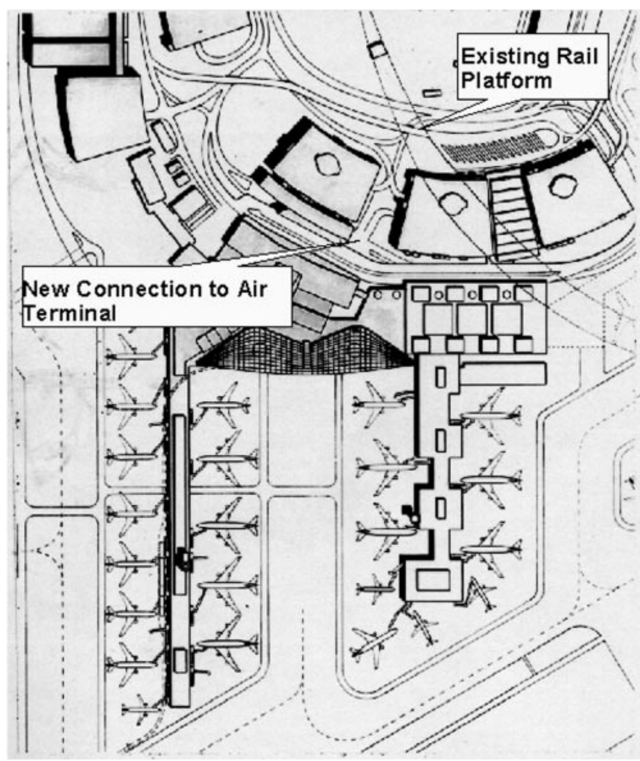

Figure 5-22. A new connection to the air terminal complex will be built in Zurich.
SOURCE: Zurich Airport, 1999.

alignment missed the older portion of the airport (the terminal structure on the left) and was coordinated with the construction of a new terminal (on the right side of the diagram). In the present facility, the pedestrian connections from the arrival hall to the basement rail line cause the traveler to walk up, over, and down, using a path over the airport access road, then down several stories to reach the lower level of the platform.

The needs of the rail user have guided the development of the expansion of the airport and the development of a midfield airside concourse. Specifically, the mezzanine level of the rail station is being extended directly under the access road to allow direct access to the adjacent main terminal and a new air passenger departure center being constructed. A new set of escalators from the mezzanine level will replace the up-over-and-down path over the access road. A people mover connecting with the new midfield concourse will leave from the same level as the mezzanine of the rail station. To serve the rail user better, 60 new airline check-in positions will be built on the mezzanine level of the rail station, minimizing the need for changes of level for those passengers carrying baggage.

Zurich Airport officials have committed to a public policy goal of 50 percent mode share to public transportation for air passengers and a 40 percent mode share for employees.

Retrofitting the Multiple Terminal Airport: Heathrow

Airports with multiple landside terminals will continue to be a challenge to the ground access designer. At present, both the London Underground and the Heathrow Express central terminal area stations are located in a plaza between Terminals 1, 2, and 3. The passenger gains access to the rail stations by long, poorly lit underground walkways.

The future layout of Heathrow poses a greater challenge, as the new Terminal 5 is not contiguous with any other terminal. Plans call for the Heathrow Express trainset to split in two at the first station, with the front section proceeding to Terminal 5 and the back section proceeding to Terminal 4. To accomplish a similar function, half of the Piccadilly Line service will be routed to Terminal 4 and half to Terminal 5, as shown in Figure 5-23.

Alternative Locations for Check-In at the Airport

Auxiliary Locations Within the Airport

In some cases, the connection between the airport terminal and the rail line will pose new design challenges. Even in

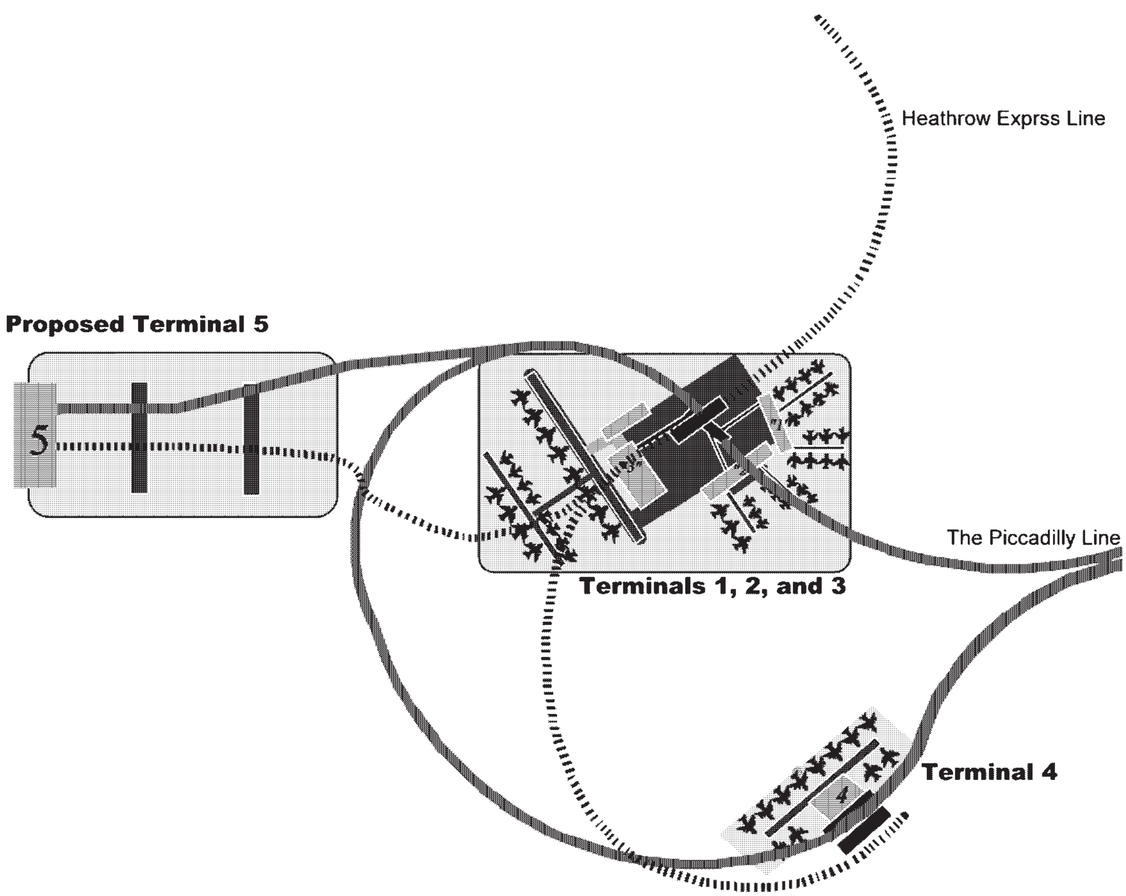

Figure 5-23. Heathrow Airport will have three major terminal areas, making rail access a challenge.
SOURCE: Matthew A. Coogan.

the case in which the rail has been well integrated into a new terminal at the airport, there may be long walking distances involved in getting to the plane. At Copenhagen Airport, the new Terminal 3 complex is directly connected to the new rail line, but walking distances to the other terminals are still a problem. To address the needs of the rail user with cumbersome baggage approaching the airport, an additional check-in facility that serves all the flights of the airport has been placed in the lobby of the rail station (Figure 5-24). Since the airport's opening in 1982, Munich travelers departing with Lufthansa have had the benefit of a special check-in area located immediately in the mezzanine lobby of the rail station. Now, with Lufthansa providing check-in services for all airlines of the Star Alliance, other airlines are offering check-in services at the mezzanine lobby of the rail station. As noted above, the reconstruction of the Zurich airport will add some 60 check-in positions at the mezzanine level of the rail station.

The Check-In Facility in the Airport Rail Station

Each of these auxiliary check-in locations is located within the airport in order to improve service for the passenger continuing to the gate on foot. The concept is being applied on a larger scale with people movers in several new projects at German airports. In Frankfurt, a second airport rail station serving the ICE high-speed rail system has been constructed. Because of the complexity of routing four new high-speed rail lines, it was impossible to expand the existing station, which is located in the basement of Terminal 1. The new rail station is located across a major expressway, which is not convenient for the air passenger who is going to either Terminal 1 or Terminal 2. The new rail station location required an extensive program to improve the quality of access to the air terminals. In the final design, a people mover will connect the new station and adjacent hotel and convention center complex with the new Terminal 2; moving walks over bridges will connect the new station to the original Terminal 1.

To aid the provision of the seamless transfer, the German Railway has built a significant complex within the rail station itself. This includes the construction of a frequent traveler lounge immediately above the tracks and a full-scale airline check-in facility as part of the rail station complex (Figure 5-25). In a highly unusual design strategy, airline passengers with through-tickets on the rail system will claim their airline baggage at the rail station; customs clearance is located there.

The concept of a major check-in facility located at the point of transfer for the rail passenger is a common theme in developing plans for AirRail terminals in Germany. At Düsseldorf Airport, it was determined that it would not be cost-effective to reroute the major high-speed rail line off of its alignment and into the airport terminal area, a distance of 1 mi. Instead, a new people mover is being built to connect the air terminal with the existing alignment of the high-speed rail system. Figure 5-26 shows the point of transfer between the high-speed rail service and the airport people mover, where a full-scale airline check-in facility will be built at the mezzanine level of the train station.

Moving the Air Terminal to the Airport Rail Station

In the examples of the Frankfurt and Düsseldorf Airports, the designers have added a second, or auxiliary, check-in facility that is convenient for those passengers who access the airport by rail. A more aggressive strategy is being implemented at the Leipzig/Halle airport, in the former East Germany. Here, all landside terminal functions (check-in, baggage claim, etc.) will be relocated to the mezzanine level of the new high-speed rail station (described as the "Central building" in Figure 5-27).

Photo: Matthew A. Coogan

Figure 5-24. A check-in station (left) is located in the rail station at Copenhagen Airport.

Figure 5-25. The new rail station in Frankfurt International Airport has airline check-in services in the rail station lobby.
SOURCE: Frankfurt Airport.

Figure 5-26. Airline check-in functions occur in the new Düsseldorf International Airport rail station.
SOURCE: Düsseldorf International Airport website (www.duesseldorf-international.de/).

Figure 5-28. An architectural rendering of the Leipzig/Halle air terminal at the high-speed rail station.
SOURCE: Düsseldorf International Airport website (www.duesseldorf-international.de/).

The existing airport complex is located to the south of the rail line; the next phase of development will occur on the north side of the rail line. The landside services of the existing airport are being moved to a "bridge" over the high-speed rail line, which will become the central element of the new airport. The architectural expression of this multimodal terminal, located over the rail and highway, is shown in Figure 5-28.

Leipzig is not the only airport to propose relocating the air terminal complex to the main line rail station. The long-term plan for London Luton Airport, to the west of London, calls for the landside functions of the existing airport to be relocated approximately 1 mi away to a new intermodal terminal that will be built over the main line tracks to London. A people mover would then connect the new landside air terminal with the airside concourses. The plan has a series of phases; initially, the check-in functions at the rail station will be linked to the existing airport terminals by bus.

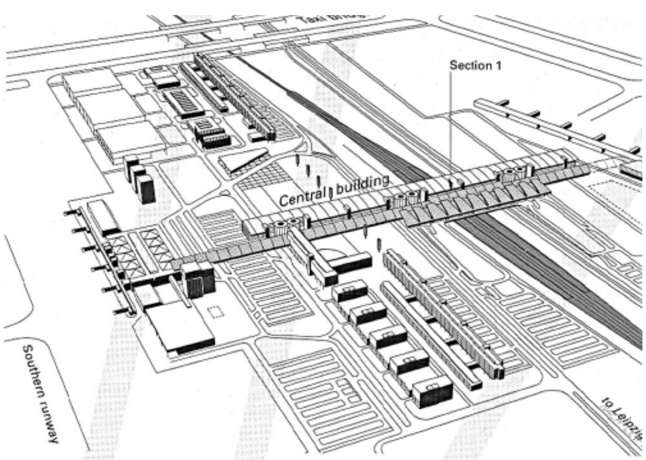

Figure 5-27. The airport passenger terminal at Leipzig/Halle Airport will be relocated to the new high-speed rail station.
SOURCE: Leipzig/Halle Airport.

Because Luton Airport is located on a main commuter rail line, existing express service links the Luton train station with London's Kings Cross Station in about 20 min. Kings Cross Station will become a critical international interchange point when both the "Eurostar" Chunnel service and a new Heathrow Express service are routed there later in the decade.

Lessons Learned: Alternative Check-In Locations at the Airport

For many U.S. airports, it will be difficult to develop rail service to all airport passenger terminals—a design characteristic of most of the successful airports in this study. Many U.S. airports plan some form of people mover to link the terminals with rail services. Others are considering the creation of "ground transportation centers," from which all forms of public transportation would be dispatched. The emerging pattern of auxiliary check-in services in Germany and in other countries is relevant to the design and planning of these U.S. transfer facilities. With the reconstruction of Reagan National Airport, US Airways has added an auxiliary check-in position at the terminal entrance serving the pedestrian bridge connecting from both the WMATA Metro station and the principal parking garage. Placement of this check-in desk at the bridge level of the terminal eliminates the need for the rail transit user to proceed up one level to the main check-in area and then proceed back down to the departure concourse. In Hartsfield Atlanta Airport, Delta Air Lines has opened a check-in facility at the level of the rail station.

At the present time, the potential of baggage check-in services at Jamaica Station is being explored to support the new rail connector service to JFK Airport. Designers of Miami's Intermodal Center are examining the option of a second location for airline baggage claim, inside the new intermodal transfer facility; this facility is similar in concept to the facility being built as part of the new Frankfurt Airport ICE rail station. The option of adding check-in service at Newark Airport's new rail station serving New Jersey Transit rail services has been preserved in the existing designs.

In the successful rail systems, a wide variety of strategies are being developed to help the user who accesses the airport by rail. From the 60 new check-in stations at the Zurich Airport rail station, to the ambitious plans for airline baggage claim and customs clearance at the Frankfurt Airport rail station, to the plans to move airport terminal functions to the rail stations in Leipzig and Luton, the successful rail systems are using alternative check-in strategies to provide seamless transfer.

The Role of Airport Configuration

Some forms of airport configuration are easier to serve directly by rail than are other forms of configuration. At the extreme ends of the spectrum, the relationship between airport configuration and ground access systems can be observed. There are currently no plans to take any form of rail service to Charles de Gaulle Airport's existing Terminal 1, which was originally conceived as an element of a highly decentralized airport. London's Heathrow Airport will operate five separate terminals, clustered as 1, 2, 3, (the central terminal area) and 4 and 5. In the United States, New York's JFK Airport will require nine stations in order to serve adequately all the airport activity areas.

At the other end of the spectrum, all services from Oslo Airport and Hong Kong Airport leave from one transfer point, which is located next to baggage claim or customs clearance. Airports with highly centralized landside facilities appear in Zurich, Geneva, Oslo, Stansted, Hong Kong, and Milan. Most airports built from the ground up are now being planned to utilize a single landside terminal rather than multiple unit terminals; the new Berlin Brandenburg International Airport is an example of this.

As shown in Table 5-4, most of the airports with the highest mode shares to rail are characterized by direct rail connections to a single, centralized point of transfer to a compact airport landside terminal. Of the top 10, only Tokyo Narita and Heathrow Airports have adopted a two-station strategy. Within our sample of 14 airports, only 2 rely on either a bus or a people mover to get from the train to major air terminals; both airports are in Paris, and both rank near the lowest in mode share attracted to rail.

TABLE 5-4 Single-terminal versus multiterminal airports

Airport	Rail mode share	Number of stops at airport	Compact terminal complex
Oslo	43	One	Yes
Tokyo Narita	36	Two	No
Geneva	35	One	Yes
Zurich	34	One	Yes
Munich	31	One	Yes
Frankfurt	27	Two	One
Stansted	27	One	Yes
Amsterdam	25	One	Yes
London Heathrow	25	Two	No
Hong Kong	24	One	Yes
London Gatwick	20	One	Partial
Brussels	16	One	Partial
Paris de Gaulle	15	Two	No
Paris Orly	6	No direct	No

Lessons Learned: Quality of the Rail Connection at the Airport

The Importance of the Seamless Connection

The successful rail systems provide a wide variety of concepts of value to the U.S. practitioner seeking to design an effective connection between the airport terminal and the rail platform. Perhaps more than any other transfer facility in the world, the Hong Kong Airport rail station demonstrates the attention to detail desired by the air passenger. The path from baggage claim to the rail vehicle should be as direct as possible, even if this is difficult to accomplish. The level of facility integration at the Hong Kong airport can be considered a goal to be sought by designers in the future. The rider, carrying baggage, walks from the customs clearance point to the train without changing levels and without ever using turnstiles or any form of impediment. Similarly, the simplicity of the pedestrian path from the Oslo airport's arrival hall to the common departure platform represents a design attribute to be emulated.

The available data reveal that good integrated connections at the airport are correlated with successful mode share, but that good connections are a necessary but not sufficient element of a total strategy. The terminal design with the highest quality for the rail user—that of the Hong Kong airport—captures about 21 percent of its market, placing the airport in the top 10 in terms of market share, but lower than the top 5, each of which attracts more than 30 percent mode share.

The case studies presented in Chapter 4, however, suggest that many airports have neither the centralized characteristics of the Hong Kong airport nor the decentralized characteristics of Dallas/Fort Worth Airport. Most can be categorized as somewhere in the middle. Expanded air traffic has caused the creation of multiple landside air terminals in airports originally designed to operate from one terminal, including Tokyo Narita, London Gatwick, and Frankfurt Airports. Most airports in the sample grew incrementally, with one rail facility now expected to serve several terminal buildings, as in the Brussels and Copenhagen airports. For each of these incrementally developed configurations, solutions have to be designed to help the passenger connect with the rail vehicle as seamlessly as possible.

ELEMENT 4: THE IMPORTANCE OF A STRATEGY FOR BAGGAGE

Creating a strategy to deal with the problem of baggage is a challenge for all designers of airport ground access systems.

The responses to the problem range from doing nothing to developing elaborate, full-service off-site check-in facilities. However, a variety of lower-cost options are being tested around the world. To explore the issue in some detail, the solutions for baggage handling can be examined in terms of two major categories: (1) full-service downtown check-in centers and (2) national schemes to deal with many off-site check-in opportunities.

Full-Service Downtown Check-In Centers

The downtown check-in center at London's Paddington Station can be used as a best case practice for off-site check-in facilities. The Paddington Station check-in system is the newest in the field and can be compared with the experience at London Gatwick Airport and in Hong Kong.

Photo: Matthew A. Coogan

Figure 5-30. The bag is checked in.

Heathrow

At Paddington Station, a new airport check-in center, complete with food services and concessions, has been built as part of the Heathrow Express project (see Figure 5-29).

The Heathrow Express operates on two tracks, tracks 6 and 7, located in the center of Paddington Station. A total of 28 check-in stations have been built as shown in Figure 5-30. Bags must be checked in 120 min before flight time, which is the same time as is required at the airport for international flights, but somewhat longer than is required for domestic flights.

Baggage is routed onto a conveyor belt running under the platform. Between the baggage check-in facility and the front of the train, a long secure tunnel has been built (see Figure 5-31).

At a secure location at the front of the train, the baggage belt rises to the level of the platform, where each bag has its bar code read and is entered into the tracking system (Figure 5-32). Bags are placed in a container, of which there is one for each of the four terminals at Heathrow Airport. The container is then padlocked (Figure 5-33). At this point, the computer system has tracked the placement of each bag into each container.

The container system is not automated, and the container is pushed by the attendant onto the baggage car, which is located immediately behind the cab of the airport-bound train (Figure 5-34). As each container leaves the handling area at Heathrow Airport, it is scanned into the system, which then has a record of the time when each bag has been transferred from the rail system. Containers are carried to each of the four terminals by four airport trucks. At the specific terminal, the bags are entered into the terminal baggage system with other bags being checked in at the terminal.

Photo: Matthew A. Coogan

Figure 5-29. London's Paddington Station is the newest downtown check-in center.

Photo: Matthew A. Coogan

Figure 5-31. The bag is sent on a conveyor belt under the platform to the head of the train.

Photo: Matthew A. Coogan

Figure 5-32. The bag is scanned at the platform level and loaded into a container.

The procedure of unloading the empty containers and loading the baggage takes place over the full cycle of the train's waiting time at the downtown station, which is currently 15 min. (It is operating policy that there is always a train waiting at the downtown station.) A recent analysis by the International Air Rail Organisation of the baggage system for Heathrow Airport reported that the system is staffed with 15 employees: 3 assigned to the conveyer, 2 loading the trains, 5 unloading the trains, and 5 distributing the bags at Heathrow.

Hong Kong

MTRC provides downtown check-in service for its Airport Express service at two locations: the downtown Central and Kowloon Stations. The operation of the baggage-handling system has been so efficient that travelers can now check bags in at the downtown Central Station only 90 min before

Photo: Matthew A. Coogan

Figure 5-34. The container is pushed onto the train.

flight departure—the same time the traveler would have been required to be at the airport.

Hong Kong Airport Express officials report that 53 percent of those passengers using the trains now use the check-in service, with peak levels as high as 70 percent. Although these numbers are high, it can be noted that the Hong Kong airport is exclusively an international airport, with most major destinations several hours away. Thus, trip duration tends to be longer, and the percentage of travelers checking bags is very high (*50*).

The design of the downtown Central Station can be compared with design in Paddington Station. To keep running times to a minimum, the Kowloon Station loading operation must be completed within the 60-second dwell time established for the station. Because of these constraints, the designers of the Hong Kong system specified an automated, mechanized system to get the containers on and off of the train (see Figure 5-35).

Photo: Matthew A. Coogan

Figure 5-33. The container is locked.

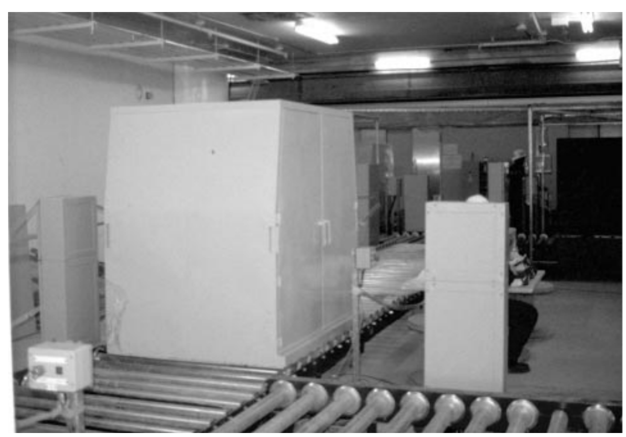

Photo: Matthew A. Coogan

Figure 5-35. The container system in Hong Kong is automated.

The layout of Hong Kong's Central Station is fundamentally different than that of the Heathrow Express at Paddington Station. Because the Hong Kong designers were starting from scratch as opposed to retrofitting an historic structure, the design of Central Station allows for the passenger check-in hall to be located immediately above the front end of the train on the platform below. Thus, baggage checked in at ground level is sent on two spiral ramps to the baggage transfer room immediately below (Figure 5-36). At the baggage transfer room, bags are placed in containers, which are designed to be automated. During the first months of operation, Hong Kong Express management decided to postpone the startup of the automated system. Staff attendants pushed the containers on and off the baggage car in a manner similar to the permanent system for Heathrow.

The baggage transfers at the Heathrow and Hong Kong downtown stations occur at a secure point on the platform, an area where the public cannot gain access. Systems operating in Switzerland and for the Gatwick Express must transfer the baggage on a working platform.


Photo: Matthew A. Coogan

Figure 5-36. The Hong Kong transfer facility is directly under the downtown check-in area.

Gatwick

The baggage car of the Gatwick Express is located on the first car of the train on the inbound direction. Thus, all passengers gaining access to the train must pass by the loading operation, as shown in Figure 5-37. Heathrow Express avoided this configuration with the construction of the conveyor belt tunnel under the platforms.


Photo: Matthew A. Coogan

Figure 5-37. A traditional baggage car is used in the Gatwick Express.

Passenger check-in occurs at a second-story location for British Airways and at the platform level for American Airlines. The upper level check-in facility, which is dedicated to British Airways, has 16 desks and is served by an elaborate taxi drop-off/pick-up area that is conveniently located off of the street. Some 300,000 Gatwick passengers use the British Airways facility at Victoria Station. Bags must be checked in 120 min prior to plane departure. See Figure 5-38.

Photo: Matthew A. Coogan

Figure 5-38. American Airlines uses a rolling container at Victoria Station.

Because those passengers checking in at the American Airlines platform level have direct contact with the departing train, this platform-level location is seen by local officials as the model for later alterations to the station. Officials are now examining plans to consolidate the operations at a platform-level location.

Gatwick officials report that about 25 percent of rail travelers making long-distance flights use the downtown check-in service, but few of the domestic flyers use the service.

Osaka's Kansai

Another example of downtown check-in services is the service from Kansai International Airport to the Namba downtown air terminal in Osaka, the only airport check-in rail station in Japan. Express service is operated every ½ hr, utilizing both dedicated-express and local express services.

Kuala Lumpur

Of all the airport off-site check-in schemes being developed, only Malaysia's Kuala Lumpur International Airport is proposing off-site baggage claim for their downtown terminal, located at the Kuala Lumpur City Air Terminal at KL Sentral Station. The project proposes to establish the City Air Terminal at Sentral as a separate three-letter International Air Transport Association (IATA) code, allowing passengers to check their baggage to the city rather than to the airport. This concept was examined in depth in the development of the Hong Kong system and again for the Heathrow Express. One factor of concern to the Hong Kong designers was the amount of space needed by a full-scale baggage-claim area. Another concern has been the possibility that travelers will inaccurately specify the actual destination, whether at the time of ticket purchase or at the moment of check-in. As noted earlier in this section, bags checked to rail stations in Germany will be routed to the auxiliary baggage-claim area in the new Frankfurt Airport high-speed rail station, which presents something of precedent for the ambitious Kuala Lumpur proposal. (A similar concept is under consideration for the through routing of bags in the Miami Intermodal Center.)

Munich

Initially, planners of the new Munich Airport had hoped to integrate a downtown check-in concept with the major public ground access mode, the S-Bahn. Toward this end, a check-in station operated by Lufthansa Airlines was inaugurated in Hauptbahnhof Station. However, there was no agreement on the question of who would pay for the baggage-handling space for each of the S-Bahn trains serving the airport. The transit agency took the position that it needed the capacity for its primary function—serving passengers. A compromise was reached, and the baggage was carried to the airport on the airport bus, which was routed to Hauptbahnhof Station. The check-in facility was small, with only two check-in desks (see Figure 5-39). Lufthansa abandoned the operation in the mid- 1990s, replacing it with an automated check-in machine for those passengers with only carry-on baggage.

Lessons Learned: Full-Service Downtown Check-In Centers

Many U.S. cities, including St. Louis, Atlanta, Chicago, and New York, have considered the construction of major downtown check-in terminals. So far, in the international experience, only London, Osaka, and Hong Kong have made the concept work for rail systems. Using buses, there is a long tradition in Scandinavia of downtown check-in; Tokyo Narita Airport is served by a downtown check-in center for luxury bus operations.

Photo: Matthew A. Coogan

Figure 5-39. Lufthansa offered downtown baggage check-in at Munich's Central Station.

This full-service downtown check-in strategy is based on the concept that the airlines will provide full services at the off-site location, in addition to staffing the check-in site at the airport. As discussed below, alternative concepts are now being developed in which third parties who are not employed by the airlines are authorized to check baggage through to its final destination and, in some but not all cases, to provide airline boarding passes.

The key element in adopting a full-service check-in operation is the effective cost allocation of providing the service. At the Hong Kong airport, little progress was made in developing the concept until a financial deal was reached with the dominant carrier for the airport. Then, the competing airlines realized they had to provide similar services. Even with this leadership from a major airline, the cost negotiations between the transit agency and the airlines proved to be particularly difficult. Ultimately, it was determined that the transit agency had the most to gain from the operation, and it became a financial contributor to the success of the operation.

At Heathrow Airport, a compromise was reached in which the airlines pay rent (to the landlord of the building) for their check-in stations (Figure 5-40) and provide distribution services at the airport. The cost of handling bags on and off the train is considered part of the operating cost of the Heathrow Express. The U.S. practitioner should not underestimate the complexity of the operation, based on the elaborate mechanism developed for the Heathrow Express. Issues of security and the tracking of baggage location through bar code verifications resulted in a significant cost for both capital and operation of the service.

Photo: Matthew A. Coogan

Figure 5-40. The airlines pay rent to Railtrack, the owner of Paddington Station.

Photo: Matthew A. Coogan

Figure 5-41. The taxi stand at Paddington Station can dispatch eight cabs at a time.

Requirements of the Downtown Check-In Terminal

The design of the downtown terminal must address the specialized needs of the air traveler. The Heathrow Express terminal at Paddington Station and Central Station and Kowloon Station terminals for the Hong Kong Airport Express provide dedicated buses to distribute passengers to local hotels. All three terminals have active programs to maximize the efficiency of the transfer to taxis.

Of those passengers arriving at Paddington Station, 50 percent of rail passengers proceed on by taxi; 45 percent by Underground; and 5 percent by other means, including walking. The ridership on the dedicated hotel distributor bus has been a problem. In order to appeal to the business market, a good taxi connection has been a high priority. At peak hours, primarily with the arrival of business passengers in the morning, there was a problem with taxi availability, so the managers of the Heathrow Express established a shared-ride system in cooperation with the taxicab operators. The taxi pick-up area is shown in Figure 5-41.

The designers of the Hong Kong Express have paid considerable attention to the quality of transfer between the rail platform and the taxi. At Central Station, the taxi deposits the departing traveler at ground level, immediately in front of the check-in desks. The arriving passenger arrives one level below, where the taxi pick-up lane is located immediately across from the train platform level. The passengers wait inside the terminal at individual gates for the taxis to arrive, without ever waiting outdoors.

The design for the taxi interface at the downtown Kowloon Station is shown in Figure 5-42. As shown in the diagram, each of the two "finger piers" of the station is designed to support 10 taxi-loading locations at once, all from one air-conditioned waiting and queuing area. This taxi loading facility is unique in the world.

The managers of the Oslo Express have developed a joint ticket, which is good both for the train and then for the completion of the journey by taxi. Thus, the user buying an airline ticket can purchase a multimodal ticket with a single integrated fare. Such a program is also under development in support of the Arlanda Express train in Stockholm.

Strategies for National Off-Site Check-In

While full-service downtown check-in facilities staffed by airport personnel are in operation in two cities, alternative strategies that encourage off-site check-in at smaller terminals are being developed in Switzerland, France, and Germany and are under exploration in the Netherlands.

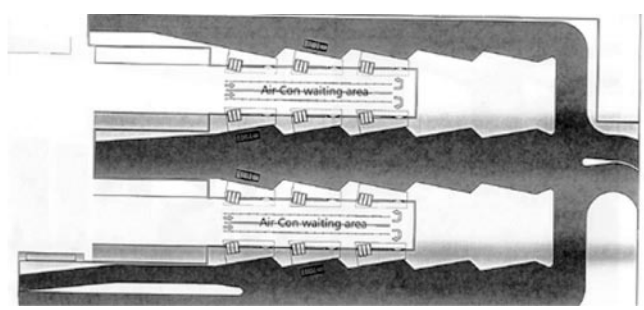

Figure 5-42. This Hong Kong taxi dispatching point could dispatch 20 taxis at a time, with all riders waiting in the air-conditioned space.

Source: Mass Transit Railway Corporation.

National Baggage Check-In: The Swiss Fly-Rail Baggage System

The concept of a national system for off-site baggage check-in is fundamentally different from the three existing downtown check-in centers serving Heathrow, Gatwick, and Hong Kong Airports or the luxury bus service serving Tokyo Narita Airport. Each of these downtown check-in terminals is staffed by airline representatives who take the responsibility for accepting baggage and issuing boarding passes. When the concept is expanded to dozens—or in the case of Switzerland, hundreds—of off-site locations, it becomes impossible to expect multiple airline companies, or even one airline company, to provide the staff at each of the off-site locations. Alternatively, a partnership with the railroads has to be built, in which the railroads are empowered to take certain actions in the name of the airlines. The Swiss Fly-Rail Baggage system has been in place for two decades; recent developments in Germany and France are refining the concept for wider application.

As described in Chapter 4, the Swiss Fly-Rail Baggage system is provided by the national railway rather than by the dominant airline. The Swiss Federal Railway charges Fr 20 (US $13) for each bag. Although the nationwide system operates from 116 locations to both Zurich and Geneva, about 80 percent of the bags are transferred through Zurich. It has been estimated that about 6 percent of the air passengers leaving Zurich Airport have made use of the system. In 1990, 275,000 bags were checked in for departure from Zurich Airport, and 100,000 bags were checked through to rail stations upon arrival at Zurich Airport. These incoming bags use a customs declaration tag that is signed when the bag is checked for its flight to Switzerland.

Although most of the examples described in the section above concerned a dominant central city check-in center, the opposite seems to be true in Switzerland. Of those bags checked through Zurich Airport, fewer than 5 percent came from the Zurich rail station. By contrast, 17 percent of the bags at Zurich came from Bern, the capital city. More than 10 percent of the bags came from major resort areas.

Mechanically, the process uses the conventional baggage system of the Swiss Federal Railways and uses the same baggage cars as other carried cargo. Each bag is taped shut with a distinctive reflective tape or sealed in a plastic bag to discourage tampering.

The German Approach to Integrated Baggage

In the context of the integration of airport access services with national rail systems, baggage strategy is just a part of a larger commitment between the German Railways and Lufthansa Airlines to replace certain local airline flights with high-quality integrated rail connections. In July 1998, Deutsche Bahn and Lufthansa Airlines signed a Memorandum of Understanding that stated that the airline will terminate feeder flights to Frankfurt from Düsseldorf, Cologne, and Stuttgart, but only if certain standards of seamless operation have been attained. The basic attribute agreed upon is that actual travel times by rail will be no longer than the present times by feeder aircraft. The memorandum calls for "full check-in from the train station of departure through to the destination airport, and uninterrupted baggage transfer from the train station of departure to the destination airport."

Yet to be resolved is the fact that, at present, the German rail high-speed equipment—the ICE train—does not have separate baggage-storage capacity.

In order to test the integrated baggage concept, a trial operation was started in June 1998 at the city of Saarbrücken. Check-in and boarding pass operations occur at the rail station, and the Deutsche Bahn rail staff place baggage in a container, which is then locked. The container is removed from the train by Frankfurt airport staff who place it into the airport's internal baggage distribution system. Lufthansa looks at the Saarbrücken experiment as a test case for wider applications throughout Germany.

In another limited application test, travelers near the rail stations at Düsseldorf, Cologne, Bonn, Würzburg, and Nuremberg can check their bags at the local station through Frankfurt Airport between the hours of 7 P.M. and 9 P.M.

Other Approaches to Baggage Handling

For most passengers accessing the airport by rail, baggage is carried on board, even when elaborate alternatives are offered in London and Switzerland. (The Hong Kong experience may be the exception.) For those passengers carrying their bags onto the rail vehicle, the availability of adequate storage areas is a key factor. The Heathrow Express has large storage areas at centrally located doors. The storage bins are built out of transparent plastics, allowing the traveler to see the bags in the storage area (see Figure 5-43). The bins are visible from some seats, but not from all.

The designers of the Oslo Airport Express, while still hoping for downtown check-in, have incorporated an unusual design feature in the new trainsets. A major baggage-storage area is placed in the center of the aisle, at the entry doors. All the seats on the vehicle are designed to allow viewing of baggage, as shown in Figure 5-44. Norwegian rail researchers found that fear of losing baggage was a major concern of passengers and designed this unusual solution.

For many years, several Scandinavian cities have offered a variety of off-site check-in services. At the present time, air travelers in business class are offered hotel check-in services at many SAS Radisson Hotels. For these users, baggage is manually placed in the airport bus and manually taken off the bus at the airport. Other hotel chains provide similar services.

Photo: Matthew A. Coogan

Figure 5-43. Baggage racks on the Heathrow Express are transparent.

Likewise, many cruise ship lines have developed innovative off-site airline check-in strategies.

Lessons Learned: Handling Baggage

Baggage-handling strategies designed to improve the trip quality for users of public transportation services to the airport remain one of the most controversial aspects of the subject of airport ground access.

Table 5-5 shows that, while the existence of off-site check-in is a positive attribute in Hong Kong and London, many of the successful systems have achieved high market share without the use of an off-site baggage strategy. Many rail systems use standard intercity rail equipment, which is designed to accommodate baggage in its normal service.

Figure 5-44. All seats face the baggage-storage racks on the Oslo Airport Express trains.
SOURCE: Adtranz.

TABLE 5-5 Strategies for handling baggage

Airport	Rail mode share	Off-site baggage aid	On vehicle provision
Oslo	43	No	Yes
Tokyo Narita	36	Bus only	Yes
Geneva	35	Yes	Intercity
Zurich	34	Yes	Intercity
Munich	31	No	No
Frankfurt	27	No	Yes / No
Stansted	27	No	Yes
Amsterdam	27	No	Intercity
London Heathrow	25	Yes	Yes / No
Hong Kong	24	Yes	Yes
London Gatwick	20	Yes	Yes
Paris de Gaulle	20	No	No
Brussels	16	No	Yes
Paris Orly	14	No	No

An off-site baggage strategy should be structured around the needs of the market. Historically, most passengers flying out of Hong Kong have been going to far distant locations, with "domestic" flights a contradiction in terms until the recent reunification with China. Long distances often correlate with longer trip duration, which correlates with more baggage. Similarly, the trip from distant towns in Switzerland may involve several train transfers and complex moves with large baggage, such as skis.

Other markets have other characteristics. At London's Gatwick Airport, use of the off-site baggage check-in for domestic flights in the United Kingdom is rare, even though the system is well used for international flights. Of those passengers accessing Zurich Airport by rail, four of five have selected not to use the extra cost baggage-handling service.

The provision of full baggage services at off-site locations is expensive for the airlines. A British Airways official estimated that an off-site check-in center would not make sense with fewer than 100,000 users a year. In both of the two new major downtown check-in centers, financial arrangements have been worked out to split the costs between the airline (which is providing a desired service to their customers) and the rail company (which is charging a high fare with the intent of making a profit on the operation). Similarly, when the Munich transit agency was asked, in effect, to donate space on board its transit vehicles, the transit agency refused.

The German model for off-site check-in is also of interest. Although the issuing of boarding passes is done by automated equipment owned by the airlines, transporting baggage is the responsibility of the railroads and is undertaken by their employees. The test run of the German system at Saarbrücken uses containers that are very similar to those used in the Heathrow Express. A key concept, according to German planners involved in the implementation of their program, is the acceptance of third parties to process the baggage from the origin point to the airport. The shared use of employees who are already in place with established work assignments could lower the incremental cost of managing baggage shipments. In this concept, the total cost for smaller operations might be significantly lower than for airline-managed operations.

Finally, the approach taken in Oslo, which will be repeated in Berlin, of providing specialized support facilities to the traveler who does carry baggage on the vehicle is worthy of note. Designers of the Oslo system, by way of example, worked extensively on the design of new, lighter baggage trolleys capable of operating safely on escalators. Managers of Gatwick Airport allow baggage trolleys on board the people mover that connects the baggage-claim area of the new North Terminal with existing rail station at the original terminal. In short, a wide variety of strategies to deal with baggage are used in the successful airport rail services.