Innovations for Airport Terminal Facilities

DETAILS

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AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP REPORT 10

Innovations for Airport Terminal Facilities

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AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

The need for ACRP was identified in *TRB Special Report 272: Airport Research Needs: Cooperative Solutions* in 2003, based on a study sponsored by the Federal Aviation Administration (FAA). The ACRP carries out applied research on problems that are shared by airport operating agencies and are not being adequately addressed by existing federal research programs. It is modeled after the successful National Cooperative Highway Research Program and Transit Cooperative Research Program. The ACRP undertakes research and other technical activities in a variety of airport subject areas, including design, construction, maintenance, operations, safety, security, policy, planning, human resources, and administration. The ACRP provides a forum where airport operators can cooperatively address common operational problems.

The ACRP was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), and the Air Transport Association (ATA) as vital links to the airport community; (2) the TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academies formally initiating the program.

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

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FOREWORD

By Michael R. Salamone
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ACRP Report 10: Innovations for Airport Terminal Facilities, provides useful synopses of the latest worldwide developments in landside facilities design and discusses future trends and innovative passenger service/processing concepts. The report describes the need for design innovation to serve and process passengers, discusses how innovation can meet many of these needs, and presents several state-of-the-industry design inventions. It explores such innovations as a process-based departure hall, self-service bag check, a drive-through processing area, elder-friendly baggage devices, alternative curbsides, and arrival lounges. The report will be of interest to airport and airline facilities, real estate, and operations managers, as well as airport planners, architects, and engineers interested in new concepts that can stimulate design and innovation in landside facilities at airports.

Airport terminal landside facilities evolve in response to changes in travelers' needs and industry development and regulation. New functions, services, and processes must be accommodated as they appear even when the facility was not originally designed for the purpose. Increases in passenger and baggage screening, provisions for self-service check-in, blast protection, an aging population, persons with disabilities, and the need to improve intermodal connections are among the various functions, services, and processes that are currently necessitating design invention.

To address such demands, some airports have moved functions from their traditional locations, reallocated space within the terminal, converted and reconstructed facilities, or created new types of facilities. Such changes have varied impacts on passengers' experience, airlines' relationships with their customers, and airport revenues and costs. Research is needed on the interface between various airport terminal landside elements (e.g., garages, roads, curbs, terminals) to identify improved ways of accommodating new airport terminal functions.

Under ACRP Project 7-01, Corgan Associates, Inc. was asked to describe new concepts that will stimulate design innovation for terminal landside facilities at FAA-designated large- and medium-hub airports to improve passenger accessibility and level of service between ground transportation and the secure parts of the terminal.

This report is not intended to present turnkey concepts for any airport. Rather, it intends to stimulate design innovation by inspiring adoption and adaptation of these concepts to each unique airport environment. Although some of the concepts are presently working at a few airports, other concepts will require a consensus among airport, airlines, and regulators before they can be implemented fully and successfully. Further research may examine operational, technical, and legal issues as well as examine means and methods used around the world.

CONTENTS

SUMMARY

Innovations for Airport Terminal Facilities

Airport terminal and landside projects are projected to account for well over one-half of the planned development costs at large- and medium-hub airports in the United States over the next 5 years. With construction costs increasing faster than inflation, the need for innovative solutions to address the common terminal and landside issues facing many U.S. airports is more crucial than ever.

Objectives

The objectives of this research project were to identify and develop innovations that can be implemented at airports of various sizes to improve the experience of passengers as they travel between the airport entrance and the secure portions of the passenger terminal. These innovations were then to be incorporated into concepts intended to stimulate design solutions that address the common issues passengers face on the landside portions of the terminal. Particular focus was given to the needs of the aging population. The innovations and concepts developed as part of this research effort were focused on those that could be implemented within the next 5 to 10 years at large- and medium-hub airports.

Approach

The initial steps of the research process were to review relevant published information, interview representatives of the aviation industry, and conduct on-site observations of innovations at certain airports in the United States, Europe, and Asia. The next step was to identify issues or problems that passengers commonly face and innovations that could address those issues based on innovative practices in effect at airports around the world. Two or more innovations were then combined to offer concepts that could be implemented to address the issues facing passengers. The innovations and the concepts incorporating the innovations were tested using a variety of methods, including (1) peer reviews with industry experts, (2) on-site meetings with airport stakeholders, and (3) simulation modeling to identify the potential facility impacts associated with certain innovations.

The following assumptions were made regarding the future operating environment in which the concepts could be implemented:

- Common-use self-service kiosks will become more widely implemented, especially at airports in the United States.
- Passengers will be able to tag their own check baggage, as is currently allowed in several European countries.

- Approximately 80% of the traveling public will obtain boarding passes via self-service devices or the Internet and will check baggage using self-service bag drop locations at airports; the remainder will use full-service check-in functions at airports.
- Airport operators will take advantage of the flexibility to tailor their security programs to avoid the so-called "300-ft rule," which bans any unauthorized vehicles from parking within 300 ft of the terminal when the Department of Homeland Security has elevated the threat level to "orange."

Results

The following innovations identified during this research project offer new opportunities to address common issues that passengers face on the terminal landside:

- Process-based departures hall,
- Passenger-processing facilities,
- Self-service baggage check,
- Bag-check plaza,
- Supplemental curbsides,
- Passenger-assistance parking area,
- Low-profile passenger baggage devices,
- High-capacity flow-through elevators,
- Consolidated meters-and-greeters area, and
- Arrivals lounges.

Each innovation was examined in terms of the key drivers for implementation, the assumptions or prerequisites for implementation, potential benefits from both the passenger and airport operations perspectives, and challenges to implementation. Although the innovations are discussed separately, it is intended that they be regarded as a "kit of parts" for future planning and design efforts.

The concepts incorporating innovations were divided into landside and terminal concepts. The landside concepts are focused on the development of processing facilities that could incorporate passenger and vehicular functions that typically take place in, or immediately in front of, a terminal building. The terminal concepts relate to passenger processes inside the terminal building. All of the concepts are intended to improve the passenger experience by leveraging technology to make the processes and operations more efficient. They are applicable to either new construction or renovations.

It should be emphasized that—although many innovations and concepts are described and illustrated in this report—it is not intended to be a design manual. Each airport has its own unique configuration and challenges. The expectation is that this report will stimulate the appropriate innovative solutions to meet those challenges.

CHAPTER 1

Background

This chapter presents the objectives of this research project on new concepts for airport terminal landside facilities and the need for such new concepts, lists the chapters included in the report, presents definitions of the terminology used to ensure a consistent understanding, and discusses the assumptions underlying the development and refinement of the innovative concepts for airport terminal landside facilities.

The intended audience includes airport management; other airport stakeholders, such as airlines and ground transportation operators; and airport terminal and landside facility planning and design consultants.

Research Objectives

The objectives of this research project were to identify innovations and develop innovative terminal landside facility concepts that can be implemented at airports of various sizes to improve the experience of passengers as they travel between the airport entrance or remote airport facility and the secure portions of the passenger terminal. The innovations were then incorporated into landside and terminal facility concepts intended to stimulate innovative design solutions to address the issues commonly faced by passengers on the terminal landside. Particular focus was given to the needs of the aging population.

The identified innovations and the concepts incorporating the innovations developed as part of this research effort focus on large- and medium-hub airports (at least 1.00% and between 0.25% and 0.99% of total U.S. passenger boardings, respectively), as designated by the FAA, with the intent that they could be implemented within the next 5 to 10 years. The innovations rely primarily on proven technologies, common processes, and current regulatory conditions in effect throughout the world, but may not be widely implemented within the United States or may even be currently prohibited by U.S. regulations. The intent of examining opportunities not currently implemented within the United States is to stimulate movement toward more forward-thinking practices and policies.

Need for Innovation

In May 2007, Airports Council International–North America (ACI-NA) estimated that airport operators will spend approximately $17.5 billion per year, or $87.4 billion total, in 2007 through 2011 just to keep up with the FAA's forecast of airline traffic growth (*1*). Large- and medium-hub airports are expected to account for approximately 73% of the total planned investments, with terminal and landside projects representing 65.2% and 71.1%, respectively, of the development costs at large- and medium-hub airports (*1*). With construction costs increasing faster than inflation (*1*), the need to identify cost-effective solutions to improving the level of service that passengers experience at airport terminal landside facilities is more crucial than ever.

Report Organization

This report is organized into the following chapters:

- Chapter 1: Background
- Chapter 2: Research Findings
- Chapter 3: Approach to Developing New Concepts
- Chapter 4: Innovations
- Chapter 5: Landside Concepts
- Chapter 6: Terminal Concepts
- Chapter 7: Conclusions

Chapter 1 establishes the objectives of the research effort and the need for innovation, presents the basic definitions of terms used throughout this document, and outlines the key assumptions used to develop the innovative concepts and the intended goals for those concepts. The definitions of terms are provided to minimize confusion regarding the meaning of the terminology used throughout the report compared with the way the same terms may be more loosely used in practice. The key assumptions are central to the viability of the innovative concepts and, therefore, are also identified in this chapter presenting the background for this research project.

Chapter 2 summarizes the findings of the research conducted for this project, which included a published document review, interviews with airport industry representatives, and airport site visits. The relevant research yielded the basis for establishing the key processes that passengers experience between the airport entrance and the secure portions of the terminal and for identifying the critical issues that commonly affect passenger level of service. Examples of recent innovations at several airports are presented as the foundation for developing and evaluating the innovative concepts in this research project.

Chapter 3 describes the research approach to developing new concepts including the identification of passenger processes, issues that passengers commonly face, innovations that could address those issues, and concepts incorporating the identified innovations; the evaluation process is also described. The concepts are grouped into landside and terminal concepts.

Chapter 4 describes the innovations in detail and provides in-depth examination of the drivers and assumptions or prerequisites for each innovation as well as an evaluation of their advantages and disadvantages. Potential challenges to implementation are also discussed.

Chapters 5 and 6 examine how the innovations can be incorporated into concepts that apply to both landside (Chapter 5) and terminal (Chapter 6) facilities. The compatibility of the concepts with existing landside or terminal facilities or paradigms (i.e., single-level terminal with a single-level roadway, two-level terminal with a two-level roadway, etc.) and the advantages and disadvantages of each concept are examined. Potential challenges to implementation are also discussed.

Chapter 7 presents the conclusions of this research project by examining the potential benefits of the results as well as their applicability to airport practice. Suggestions for further research, related to the innovations and concepts presented in this report, are also provided.

An appendix presents the computer simulation analysis results, which estimated facility requirements for a process-based departures hall concept and a landside bag-check plaza concept.

Definitions

Terms used in the aviation industry often have several definitions and can be used in a variety of ways depending on the point of view and background of the person using the terms. To provide clarity, definitions of the key terms used in this report are provided below.

- **Automated people mover (APM):** fully automated, grade-separated, fixed-guideway transit system that provides passenger transfer between key components of the airport.
- **Bag drop:** a staffed or non-staffed position where passengers use a self-service device to acquire tags for their check baggage and the baggage is input into the baggage-handling system.
- **Baggage make-up:** facilities in the secure area of the terminal where the airlines consolidate checked baggage for loading onto the aircraft.
- **Check-in:** using an e-ticket (via a kiosk, the Internet, or an airline agent) to acquire a boarding pass or deposit check baggage.
- **Check baggage:** passenger baggage that is surrendered at the point of check-in, subject to explosives detection system (EDS) screening, transported in the belly compartment of the aircraft, and retrieved in the baggage claim hall.
- **Commercial vehicle (CV):** generally includes taxicabs, town cars, prearranged limousines, courtesy vehicles, chartered vans and buses, shared-ride door-to-door vans, and scheduled buses.
- **Common-use:** the sharing of facilities (ticket counters, kiosks, baggage-claim devices, etc.) among multiple airlines based on demand rather than exclusive-use provisions.
- **Common-use self-service (CUSS):** the sharing of facilities, such as kiosks, offering check-in by the passenger (potentially including baggage check) while allowing multiple airlines to maintain branding and functionality.
- **Concept:** graphic illustration of a potential opportunity to integrate one or more innovations with real-world situations at airport landside or terminal facilities.
- **Curbside:** that portion of the terminal area roadway used to drop off or pick up passengers.
- **Bag-check plaza:** drive-through facility that offers self-service check-in and baggage check within proximity of the passenger's vehicle.
- **Forecourt:** an area that includes various vehicle and pedestrian processing functions that is separated from the terminal building by a courtyard or other pedestrian-only plaza.
- **Full-service:** use of an airline or airport agent to buy a ticket, modify a reservation, obtain a boarding pass, and deposit check baggage.
- **Innovation:** something newly introduced, such as a new idea, method, or device.
- **Landside:** public (nonsecure) portion of the airport from the airport entrance(s) up to the face of the terminal building(s) that facilitate both vehicular and pedestrian movements and may include check-in functions.

- **Nonsecure area:** public areas of the terminal that departing passengers access before entering the security screening checkpoint (SSCP) and that arriving passengers access after leaving the secure area.
- **Passenger assistance parking area:** a parking area that provides for vehicles to be left unattended briefly while passengers are being assisted to or from the terminal.
- **Passenger processing facility:** facility located on the airport landside that combines some or all of the functions typically found in a passenger terminal with those found in other facilities, such as a parking garage or consolidated rental car facility (CRCF).
- **Privately owned vehicle (POV):** includes private vehicles and rental cars.
- **Regional transit:** fixed-route service via CV or rail that connects the airport with regional or urban transportation networks.
- **Secure area:** public areas to which passenger and other public access is controlled by an SSCP.
- **Self-service check-in:** use of a self-service device or the Internet to obtain a boarding pass or surrender check baggage without personal contact with an airline or airport agent.
- **Self-service device (SSD):** a kiosk used by passengers to obtain a boarding pass and in some cases a baggage tag.
- **Terminal:** public facilities located on the airport that are used for processing departing and arriving passengers. The terminal typically includes the following functions: ticketing/check-in (full-service and self-service), SSCPs, concessions, restrooms, baggage screening, baggage make-up, aircraft boarding gates, holdrooms, baggage claim, and a meters-and-greeters area. (Note: many terminals also include international arrivals facilities, which are not components of this research effort.)

Assumptions

Development and refinement of the innovative concepts—which range from holistic "blue sky" concepts that would involve a major reorganization of key passenger processing components to "immediately applicable" concepts—were based on the following assumptions, which are anticipated to materialize within the next 5 to 10 years:

1. Common-use self-service kiosks will become more widely implemented, especially at airports in the United States.
2. Passengers will be able to tag their own check baggage.
3. Approximately 80% of the traveling public will obtain boarding passes or check their baggage via SSDs or the Internet; the remainder will use full-service check-in functions at the airport.
4. Airport operators will take advantage of the flexibility to tailor their security programs to avoid the "300-ft rule," which bans any unauthorized vehicles from parking within 300 ft of the terminal when DHS has elevated the threat level to "orange."

Each of these assumptions is discussed in detail below.

Expanded Implementation of Common-Use Self-Service Kiosks

Today, only one airport in the United States, McCarran International Airport in Las Vegas, has 100% CUSS kiosks (*2*); however, several other airports such as San Francisco, Dallas/Fort Worth, Southwest Florida, and Pittsburgh international airports use CUSS kiosks to some extent (*3*). The International Air Transport Association (IATA) estimates that at the end of 2007, 85 airports worldwide offered CUSS facilities and anticipates that number growing to 130 airports by the end of 2008 (*3*).

One reason for the optimistic outlook for CUSS implementation becoming more widespread, particularly in the United States, is that it provides real financial benefit. IATA estimates that CUSS can generate an average cost savings of $2.50 per check-in and that a 40% market penetration of CUSS kiosks would save $1 billion per year (*3*). With fuel prices increasing and impacting the financial performance of many airlines, it is not unreasonable to expect that any opportunity to save operating costs will be strongly considered. In addition, airport operators are seeking ways to create more flexibility to accommodate the changes in airline service and to improve passenger throughput to avoid costly infrastructure development. CUSS offers opportunities to address both of these concerns.

Based on discussions with airline representatives, however, there is some opposition to CUSS that cannot be overlooked. First, the loss of branding and proprietary functions, such as passport scanning capability, is a concern. Some airlines provide functionality through their proprietary kiosks that other airlines do not offer. Some airlines prefer to have their own agents support the self-service kiosks so that they can be sure to offer the same level of service to all of their customers. Another concern is that multiple vendors provide CUSS infrastructure and that the airlines now have to support the integration of this infrastructure with their own systems in addition to the proprietary self-service kiosks that they maintain at non-CUSS airports.

While these concerns should not be ignored, the intent of this research is to examine the true potential that CUSS can provide from a passenger processing standpoint. In particular, this research is intended to determine how the needs of passengers can be better served with CUSS and what other operational benefits (such as increased capacity or reduced staffing) result from the use of CUSS. The true net cost implications of the CUSS kiosks are beyond the scope of this research project, but are a subject of ACRP Project 10-05, "Understanding Common-use Approaches at Airports." Based on the information presented above, the assumption that CUSS will become more widely implemented at U.S. airports is not only realistic, but also likely to occur sooner rather than later because of the potential benefits.

Self-Tagging of Check Baggage

Passengers are already able to tag their own check baggage in several European countries (e.g., Austria and Germany) and self-tagging for United States–bound travelers is being tested in at least one North American airport, Montreal–Trudeau International Airport. According to a recent magazine article (*4*):

> Some 60% of Air Canada passengers currently check-in using a Common Use Self-Service kiosk, which also offers self-tagging of bags . . . today, there are 47 CUSS kiosks. In parallel, the airport ran a pilot project with Air Canada and US Airways offering six kiosks in the transborder (Canada-US flights) sector with baggage self-tagging.

The pilot project resulted in an 86% favorable rating. In 2007, 30% of passengers who obtained boarding passes from a CUSS kiosk also used the self-tagging option (*4*).

Self-tagging of check baggage is currently prohibited in the United States. The Transportation Security Administration's (TSA's) Aircraft Operator Standard Security Program (AOSSP) currently requires that baggage destination tags will only be placed on check baggage at the point of acceptance and only by a direct airline employee or an authorized airline representative. AOSSP also requires that at the initial point of contact with each passenger checking baggage, the airline representative must request that the passenger present valid identification (ID). However, since 100% EDS screening of checked baggage is a TSA mandate and as long as the airline controls the loading of baggage into the aircraft after screening, the primary apprehension related to self-tagging of check baggage is of low anti-terrorist security concern. The bigger concern may be the potential loss or damage liability that the airlines assume by allowing passengers to place tagged bags onto the bag conveyor belt.

Self-tagging of check baggage offers a number of potential benefits. First, it is the logical next step in allowing passengers to serve themselves. In today's two-step system, after obtaining a boarding pass either at a kiosk or via the Internet, passengers would be able to go to a designated self-service bag-drop location, obtain bag tags, self-tag their check baggage, and deposit the check baggage into the baggage system. In a one-step system, passengers would be able to obtain their boarding passes, self-tag their check baggage, and deposit their baggage into the baggage system, all at a single kiosk. At Vienna International Airport in Austria, where a one-step process at a single kiosk has been implemented for the printing of a boarding pass and the self-tagging of check baggage, roving agents, positioned on the same side of the counter as the passenger and serving six positions or more, can generally process 150 to 180 passengers per hour per agent (*5*), about three to four times the rate normally associated with the conventional one-step process implemented in the United States where self-tagging is currently prohibited.

In discussions with airport and airline representatives regarding passengers self-tagging their check baggage, most agreed that self-tagging presents substantial benefits and will most likely be offered in the United States in the near future. In today's environment, 100% EDS screening of checked baggage—which is a TSA mandate—reduces the need for positive ID verification prior to allowing passengers to insert their check baggage into the baggage system. Therefore, the assumption that self-tagging of check baggage will be allowed in the United States in the near future appears to be reasonable and is a major component of the innovations discussed in Chapter 4 and the concepts illustrated in Chapters 5 and 6.

Increased Use of Self-Service Check-In

The extent to which passengers currently use self-service check-in features—whether via kiosk at the airport, some other location, or the Internet—varies by location and by airline. According to a recent online article from *Revenue Management Forum*, 47% of travelers in the United States use self-service check-in compared with 42% of travelers in Europe, 40% in the Middle East, and 30% in the Asia Pacific region (*6*). The article further indicates that the percentage of passengers using self-service check-in in the future is expected to continue growing because passengers want the speed, convenience, and control that self service offers and airlines want to use the technology to offer these options and improve customer service while cutting costs (*6*). The cost savings to the airlines in providing the self-service features that passengers want would be significant. It is estimated that it costs airlines approximately $3.00 to process a passenger using an agent, but only $0.14 to $0.32 per passenger for self-service (*7*).

Many airlines have been able to reach much higher self-service check-in rates at their hubs or focus airports. More than 70% of Alaska Airlines' customers at Seattle–Tacoma International Airport use self-service check-in kiosks or the Internet (*7*). At Northwest Airlines' Minneapolis-St. Paul International Airport hub, more than 70% of its passengers check in either via the Internet or the airline's kiosks (*8*). British Airways processes about 56% of its passengers via self-service check-in and is planning to achieve an approximately 80 to 90%

share of travelers checking-in via self-service kiosks at its new state of art Terminal 5 at London's Heathrow Airport (*9*).

From discussions with representatives of low-cost and legacy carriers, airport technology providers, and airport executives, it was determined that the assumption that self-service check-in use will increase to—and most likely exceed—80% of the traveling public in the near future is very realistic. As the airport operators and airlines seek to provide cost-efficient improvements in customer service, the use of self-service check-in should also continue to increase at non-hub airports.

Flexibility to Avoid the 300-ft Rule

49 CFR §1542.101, *Airport Security General Requirements*, requires that every airport must have a security program in place, which, among other things, must include a contingency plan (§1542.301) that addresses local, airport-specific measures for blast mitigation during elevated threat conditions. In December 2002, the TSA Under Secretary for Aviation Operations reviewed the agency's list of "unnecessary rules" and removed the 300-ft rule requirement in contingency plans, also known as "Special-Category-Airport-3" (SCA-3). The rule was essentially a systemwide formulaic ban on any unknown vehicle parking within 300 ft of the terminal building at designated airports. In its place, the TSA instituted a series of operating procedures called the Bomb Incident Prevention Plan (BIPP), intended to provide relief from the SCA-3 approach by adding flexibility when tailoring an individual airport's security program. Each BIPP was required to be based on an approved blast analysis performed by a certified engineering firm, which would be instituted when the DHS threat level was elevated to "orange." Without such an analysis, the 300-ft rule remains in effect at larger airports.

The TSA-approved contingency measures for threat level "orange" in all airport security programs allow for alternative procedures, subject to approval by the TSA's Office of the Assistant Administrator for Aviation Operations, to be implemented in lieu of restricting parking within 300 ft of the terminal. These alternative procedures should be appropriate to the unique building design, local physical and operational constraints, and the perceived level of threat and may include such things as remote vehicle screening or the inclusion of blast mitigating components into the design of new or renovated terminal and close-in parking facilities.

While the alternatives for avoiding the 300-ft rule may be expensive to implement from an operations or capital cost standpoint, some airport operators have elected to accept these circumstances rather than constructing parking facilities beyond 300 feet of the terminal building. Airport representatives contacted during this research effort also indicated their willingness to seek alternative solutions or to accept the temporary ramifications, such as reduced parking capacity, rather than separating the terminal building and the parking structure by 300 ft.

CHAPTER 2

Research Findings

Three methods were used to collect relevant information on several topics that were either identified in the original project statement, or subsequently identified as being central to the topic of airport terminal landside facilities:

1. Review of relevant research in published literature and on the Internet;
2. Personal interviews with members of the aviation community; and
3. On-site observations of recent innovations at airports in the United States, Europe, and Asia.

Published Document Review

The goal of reviewing recent and current research was to identify best practices and recent innovations or future trends in airport terminal planning and design specifically related to landside facilities as defined for this project. To streamline the research efforts, the following key topics were established:

- Passenger satisfaction,
- Aging passengers,
- Industry initiatives,
- Wayfinding,
- Passenger processing,
- Innovative terminal design/future trends,
- Regional access to airports,
- On-airport ground access, and
- Public parking.

The sources used in the research and the issues identified in relation to each of these topics are discussed below.

Passenger Satisfaction

Passenger satisfaction reports were reviewed to identify the crucial issues that passengers consider when determining whether their airport experience was satisfactory. Sources of passenger satisfaction data were *Airline and Airport Passenger Opinions* (www.airlinequality.com) (*10*); *World Airport Awards* (www.worldairportawards.com) (*11*); and *North America Airport Satisfaction Study (12)*. The following issues were commonly identified by a number of passengers as having a positive or negative effect on their airport experience:

- Wayfinding;
- Multiple vertical transitions from public transportation to the gate;
- Airport/airline staff friendliness;
- Walking distances;
- Availability of self-service check-in;
- Availability of landside (i.e., pre-security) amenities;
- Signage in the arrivals hall;
- Queues at curbside, check-in, and security;
- Connections to rental car pickup/drop-off;
- Bag claim wait times;
- Availability of real-time information pertaining to wait times and gate assignments; and
- Availability of rail service to the city center.

Aging Passengers

One aspect in developing innovative concepts for airport terminal landside facilities is the effect of age on the ability of passengers and others to navigate through the complex facilities of an airport. In 2000, there were approximately 35 million people age 65 and older in the United States; that number is expected to increase to approximately 63 million by 2025, potentially representing 30 million to 60 million trips and $300 million and $3 billion in financial impact to airports and airlines, respectively (*13*). The major issues identified for the aging population are walking distances, waiting times, and wayfinding (*13*). In addition, a significant difference between disabled and aging passengers is that while disabled passengers are acutely aware of their limits, elderly people may also experience reduced mobility, agility, and stamina, but do not want to be considered disabled (*13*). Key issues for elderly passengers include the following:

- Elevators are preferred over stairs, escalators, and moving walkways.
- Lighting is very important to wayfinding.
- Prolonged standing while waiting at curbside, check-in, or security is a problem.
- Seating is needed adjacent to the queues and in the bag-claim hall.
- Information regarding the time required for arriving bags to reach the claim devices would help reduce prolonged standing.
- Transporting baggage is very challenging.
- Ground transportation should be as close to the bag-claim hall as possible (*14*).

Industry Initiatives

In 2004, IATA introduced a significant industry initiative entitled "Simplifying the Business," which was intended to respond to the substantial financial hardships that the airline industry experienced in the last few years by pursuing initiatives to improve customer service while lowering airline operating costs through better use of technology to process passengers, baggage, and cargo. The tenets of this initiative were as follows:

- To implement 100% the use of e-tickets by the end of 2007,
- To implement widespread use of CUSS kiosks,
- To enable passengers to manage all appropriate aspects of the departure and arrival processes via self-service
- To replace magnetic-strip boarding passes with bar-coded boarding passes
- To build a collaborative framework for airports and airlines to identify and address baggage handling problems
- To transition to e-freight to eliminate paper from the shipping process (*15*)

IATA estimated that these six tenets could save the aviation industry as much as $6.5 billion annually (*15*).

At many airports, new check-in strategies based on innovative methods of deploying self-service check-in kiosks have been implemented, allowing passengers to print boarding passes and/or bag tags without waiting in a queue for an airline agent.

Wayfinding

Wayfinding is much more than signage. Wayfinding allows passengers to orient themselves within the facility, provides critical information related to passenger journeys, and gives passengers clear and simple directions to their destinations.

Through the research process, several key factors that make wayfinding more effective were identified. Importantly, the changing demographics of the traveling public (aging passengers, an increase in new/inexperienced passengers, etc.) present new challenges for airport wayfinding. To account for these changes, wayfinding must be easily understandable with simple nomenclature and primary directional messages. Wayfinding must also be intuitive, which can be accomplished by clear lines of sight, visible recognizable objects, and even retracing the path taken at the beginning of the trip on the return trip. Further, directional signage should be easily recognizable amid the background of competing signage frequently found at airports.

Passenger Processing

When considering the processing capabilities of airport facilities, it is important to view the terminal and ground transportation facilities as a complete system with a complex set of interrelated subsystems, including road and rail systems, vehicle-processing and storage facilities, pedestrian access, pedestrian circulation and processing, and baggage processing. With increasing numbers of passengers and the long lead times associated with major capital development projects, a number of issues related to passenger processing have become commonplace at many airports. The following key issues were identified:

- Overcrowded walkways reduce passenger flows.
- Passengers are stressed by queues at check-in and the SSCP.
- Wayfinding is convoluted and signage is often lost in the background.
- Passengers use curbside check-in to avoid the chaos in the check-in lobby.
- Passengers have different expectations depending on their level of experience with airline travel.

Several approaches have been used at airports to help mitigate or resolve these issues and to improve the passenger's experience. Minimizing walking distances, particularly between ground transportation services or close-in parking and the terminal, helps reduce passenger fatigue and anxiety before they reach the potentially more stressful check-in and security processes. One approach, made possible as a result of the widespread implementation of SSDs, is to empower passengers to select the services they need as well as the location from which they select the required services (e.g., SSDs at a hotel or Internet check-in). For example, frequent business travelers—familiar with airport processes—may seek a fast track to the SSCP after having checked-in remotely. As some queues may be unavoidable, another strategy is to provide passengers waiting in the queue with information pertaining to their journeys, such as flight/gate information or with entertainment distractions to make the wait less stressful.

Innovative Terminal Design/Future Trends

Modern airport terminal design is a vast departure from that of the past, but there are also many similarities. One of the most notable differences is the use of technology to make the buildings and processes more efficient and customer friendly. A review of case studies and press releases regarding new terminal projects identified the following innovative designs/future trends:

- As passenger processing speeds increase, the size of the facility and the staffing requirements can be reduced while customer satisfaction increases.
- Many airport operators and the surrounding communities are considering massive investments in public transportation, particularly rail systems. The main goal will be to provide easy access between the terminal and intermodal facilities while at the same time providing a service that is financially feasible.
- Passengers desire more choices for check-in so that they may avoid unnecessary queues or agent transactions. Because traditional ticketing/check-in layouts do not provide sufficient options, the focus has shifted to automated self-service operations in a variety of locations on and off the airport.
- To improve flexibility, the shell of the terminal building can be a separate structure from the core facilities inside. As it is difficult to predict the needs of passengers and airlines beyond 5 or 10 years, this separation would allow airport operators to minimize the cost of adapting to the changing needs of airport users.
- Relocating the terminal curbside roadways into the parking garage could minimize at-grade crossings. Other traditional terminal functions—check-in, baggage check, and rental car pickup/drop-off—are now being performed in the parking garage.
- Enhanced wayfinding through the use of natural light, straightforward circulation, and large public spaces allows passengers to see more of the terminal and better orient themselves within the space.
- Hotels and business centers integrated into the terminal facilities or located adjacent to the terminal provide a greater variety of services at the airport and attract customers other than those related to airline travel.
- Renewed focus on the bag claim or arrivals hall as the passengers' first impression of the airport and surrounding area has led to more open spaces and better wayfinding in the terminal, close-in parking, and ground transportation.
- Terminal roadways are being segmented by mode of transportation rather than by departures and arrivals (e.g., ground transportation centers).
- Nonsecure people-mover systems are being used not only to transport passengers between terminals, but also to connect them to regional transit, consolidated rental car centers, and remote parking. In some locations, passengers are able to check in for their flights and check their baggage at the remote locations.

These trends were important considerations for the innovations identified in Chapter 4 and the concepts incorporating the innovations illustrated in Chapters 5 and 6 and were improved upon by combining a number of innovations.

Regional Access to Airports

Due to increasing congestion on highways, many airport operators and local and state governments are considering mass transit, high-occupancy-vehicle (HOV) use, demand management programs, and the use of technology as potential solutions to roadway congestion. While the preferred transportation mode to access airports in the United States will likely continue to be the private vehicle, airport operators continue to seek the resources to provide alternative modes of transportation for access to the airport.

The largest challenge to mass transit is funding. Securing public funding support is a major challenge for operators of both large and small airports seeking to provide HOV access by rubber-tired vehicles, a public rail system, or both.

The emergence of the low-cost carrier business model has resulted in more point-to-point airline service and a dramatic increase in the numbers of passengers at small-hub airports (between 0.05% and 0.25% of total U.S. passenger boardings) and at airports near major metropolitan areas. The increase in passengers at airports served by low-cost carriers has effectively dispersed airport-generated traffic over a larger region and away from the dominant airport serving the metropolitan area. This dispersion reduces the ability of even the larger airports to justify expensive rail projects.

On-Airport Ground Access

The travel experience from the airport entrance to the aircraft departure gate is one of the most stressful parts of the passenger's trip. Scheduled arrival and departure times during peak periods produce the most congestion on airport roadways—for example, drivers wishing to pick up passengers are often not aware of delays to arriving aircraft. Drivers who reach the curb prior to the arrival of the individuals being picked up are typically forced to move by police or traffic enforcement agents, which increases recirculating traffic on already congested roadways and causes secondary problems, including

- Increased parking along the shoulders of the access roadways as drivers wait before returning to the curbside,
- Potentially unsafe driving maneuvers resulting from drivers attempting to access impromptu parking areas or being uncertain about the return path to the terminal,
- Operational effects on traffic as drivers travel slower than the traffic flow to lengthen their travel time back to the curb, and
- Increased vehicle emissions.

Recent innovations to improve on-airport ground access vary between physical improvements and technology-based operational improvements. Airport operators are providing dedicated short-term parking lots, frequently referred to as cell phone lots, for drivers to wait for their parties to arrive. These lots are typically provided free of charge and, in some cases, have large flight information display screens that notify drivers when flights have arrived. Other innovations designed to move vehicles more efficiently through the airport roadway systems include

- Low-frequency advisory radio and variable message systems on overhead signage to notifying travelers of bottlenecks;
- Peak-hour pricing discounts that reduce or eliminate parking fees, encouraging drivers to park their vehicles rather than circle on airport roadways; and
- Automated vehicle identification (AVI), which can help track the number of commercial vehicle trips through the terminal core.

Public Parking

The demand for airport parking continues to grow. At most airports, parking is the number one source of nonairline revenue. At airports where parking lots are full on a daily basis, new ways to accommodate demand must be found. Building elevated parking structures is costly; therefore, many airport operators are exploring and implementing technology-based solutions that promote the increased use of available spaces as well as offering services to encourage customers to continue parking at the airport in the future.

New "smart parking" systems work well in close-in parking garages where a network of different colored lights is used to guide passengers to available parking spaces. Other technologies, such as "e-park," allow customers to swipe the same credit card when entering and exiting the facility. In areas with local tollway systems, airport revenue systems compatible with the tollway authority's payment transponder can be installed. At several airports, passengers are offered, for a small fee, the option to check their baggage and obtain a boarding pass upon arriving at the parking facilities.

Aviation Industry Interviews

A crucial component in identifying common issues associated with terminal landside facilities and recent innovations was to conduct interviews with a diverse set of representatives from the aviation industry, including airport management, airlines, airport technology groups, and airport ground transportation experts. A brief summary of the common issues identified in the interviews is provided below.

Airport Management

Many of the observations by airport management representatives related to the overall goal of reducing passenger stress and anxiety. One representative interviewed had developed a "stress curve" equating stress reduction not only to improved passenger satisfaction, but also to increased concession revenues.

Issues related to passengers getting to the airport included the general underutilization of transit systems by airline passengers in North America. A theory expressed in the United Kingdom was that, for a landside transit network to be effective, its own synergy is required, similar to the airside, where the addition of connecting passengers to the mix of originating and terminating passengers enables the airlines to provide a more extensive route network.

Considerable concern was expressed about curbside congestion and the reduction of recirculating courtesy vehicle trips for both congestion and environmental reasons. An innovative concept is being introduced at the new Terminal 5 at Heathrow Airport: instead of a conventional linear curb, a departures forecourt is situated on top of the parking garage—this provides more flexibility for the different departure functions and transportation modes. This concept has the added advantage that all vertical circulation on the landside is on the pedestrian side of the roadway system.

The issue of parking anxiety was also raised, and many examples of "smart" garages were noted in which vacant parking spaces are indicated along with advance notice of which garages, particularly at large airports, have available spaces via active signage or telephone information.

Discussion of the check-in process mostly focused on the amount of automation possible. Use of the Internet to obtain boarding passes and use of SSDs at the airport are recognized as coming into general use. The general consensus is that self-tagging of check baggage will eventually be available in the United States, with 80% or more of all passengers using self-service functions via kiosks at the airport or in remote locations or via the Internet. Common-use systems are seen as a viable approach, with a preference for the backbone and hardware being provided by the airport operator, with customization for each airline. The point was raised that, at single-carrier terminals (typically an airline hub), common-use systems are not as relevant as in terminals with multiple airlines.

The increased flexibility offered by common-use systems leads to greater utilization, resulting in cost savings through staff reductions and increased capacity for the airlines; however, an unintended consequence of automation has been that staffing reductions can present serious problems during periods of irregular operations when large numbers of passengers need to be rerouted.

Changing demographics were discussed with the general assumption that leisure travel will increase, although it was thought that increased leisure travel would not drive the same level of ultra-low-cost travel in the United States as it has in Europe. Leisure travel has had a major effect on airport operations through increased space requirements resulting from passengers arriving at the airport much earlier, increased volumes of checked baggage, and a lack of passenger sophistication.

SSCP queuing was raised as a concern by all, and it was generally agreed that, even though airport operators have invested in expanded screening, the TSA has not always staffed the SSCPs to capacity. Information regarding queuing times would be helpful to passengers and the registered traveler program could help; however, in its present form, this program is not perceived to be beneficial enough to attract large numbers of customers.

Another common point was that the arrivals process is typically less problematic than the departures process; however, it was noted that waiting times for checked baggage have increased, mostly as a result of staffing reductions and the lack of automation on the arrivals end. Meeters and greeters, who are not allowed on the airside, also present a problem as they typically receive arrival gate information that may not direct them to the point where their parties exit from the secure side of the terminal. Arrival points for domestic passengers should be designated and identified similar to arrival points for international passengers.

Airlines

Motivated by a desire to improve passenger levels of service and operational efficiency, the airlines are aggressively pursuing the integration of technology into their passenger-processing functions industrywide. However, some debate is ongoing as to whether common-use equipment is necessarily the best way to achieve the airlines' goals. For example, where an airline has complete occupancy of a terminal building at a hub airport, sharing technology with other airlines and terminals provides little benefit. Branding is also an issue. Whereas visual branding can be achieved through icons on flat-screen displays, airlines may consider their own particular process at a proprietary self-service kiosk to be superior to others and a common-use system would be mediocre by comparison. The participants also identified interface problems with common-use systems, which often involve the airline having to adapt its software and technology to accommodate different operating systems at different airports. It was strongly felt that industry standards are necessary and that a common backbone would be ideal; once an airline's icon is activated, the self-service process from thereon would be part of the airline's proprietary system.

Nevertheless, there seemed to be a consensus that common-use equipment is becoming more popular among airport management because of the benefits it provides, particularly in allowing flexibility for growth and contraction at both the check-in points and aircraft gates. This flexibility would be particularly advantageous at origin and destination airports and at spoke locations for hub-and-spoke airlines. A major advantage of CUSS kiosks is that they can more easily be made available at remote locations.

Baggage check was also identified as a major issue. Ideally, the airlines would like passengers to divest themselves of their bags at the earliest opportunity. Also discussed were concepts of checking bags away from the airport—either at transit locations, which has been implemented at some locations in Europe, or at home or the office through a delivery service. Remote baggage check could result in the airlines receiving bags too early and having to deal with bag storage. On-airport remote baggage check was thought to be a positive concept, especially in new construction situations where a high-speed belt could connect the check-in location with the baggage system.

It was noted that in Japan, baggage-delivery services are available to accept bags from passengers immediately after the bags are claimed and then the bags are delivered to the passenger's desired location. This service is especially beneficial when ongoing travel is by surface transit modes that may not be well suited for passengers traveling with large bags.

Curbside check-in continues to be a major problem in that the length of curbside allocated for check-in is generally directly related to the ticket counter length inside the building, which may not be sufficient. Promising concepts include those observed at certain European airports, where a forecourt with a much larger area has replaced the departures curbside, enabling multiple functions to be performed, including baggage check.

Self-tagging of check baggage was also discussed. It was generally thought that it would be beneficial for passengers to tag their own check baggage, as they do in certain European countries; however, the concern was raised that such a system would require proper safeguards to prevent passengers from making false claims for undelivered bags.

The sorting of arriving bags so that, particularly at large airports, bags could be delivered to multiple locations convenient for the customer was also discussed. It was felt that this service would be too onerous on the airlines and, therefore, unlikely to be adopted.

Another common issue for arriving passengers is waiting for rental cars or courtesy shuttles, often late at night or in inclement weather. The concept of arrivals lounges was discussed, wherein passengers could wait and be provided with real-time information as to when their transportation would arrive. This concept would provide passengers with a better environment, better security, and less stress from wondering if and when a courtesy vehicle or bus will arrive.

Airport Technology Groups

Technology will continue to play an increasing role in passenger processing. While common-use systems are gaining acceptance, as mentioned in Chapter 1, obstacles still have to be overcome. One key challenge to widespread implementation of common-use systems is the interface of hardware and software between the airport and the airlines. Also, airport management and the airlines may have different priorities as to how common-use systems should serve passengers, particularly regarding the provision of information. Self-service kiosks, for example, have great potential for providing general information and even advertising, which could be beneficial to airport management from a passenger service and revenue point-of-view beyond the typical flight and boarding information, which would be the airlines' priority.

Radio-frequency identification (RFID) is generally accepted as excellent technology; however, it has been available for almost 20 years and still has not gained widespread acceptance primarily because of implementation costs. One of the many potential benefits of RFID is that a passenger's bag could be permanently identified with an implanted chip and itinerary information could be added to the chip, resulting in simplification of the entire baggage-check process. RFID has the capability to store a great deal of information about the passenger and his or her general travel plans.

Airport Ground Transportation Experts

One of the biggest challenges facing airport planners and designers is curbside congestion. The driver of every vehicle entering the terminal area wants to load (arrivals) or unload (departures) near the terminal doors. This "pooling" of vehicles near the terminal doors creates bottlenecks, which make it difficult for through traffic to bypass the terminal. The common solution—forcing certain transit modes, such as commercial vehicles, to a second or third median curb—often causes pedestrian/vehicle conflicts. The introduction of the cell phone lot not only removes some vehicles from circling on terminal roadways, but also provides passengers the opportunity to inform their drivers where on the curb to pick them up. Another method to reduce congestion is to encourage commercial vehicle trip reductions through consolidation of the shuttle bus systems for rental cars, hotels/motels, and off-airport parking.

Regional rail connections are also an important issue. Ridership as low as 10% to 15% of originating and terminating passengers on the most highly used systems in the United States has been the main reason that these systems are difficult to justify economically and that they have not been widely implemented. The development of other functions and amenities at airports, such as conference centers and retail development, could result in increased transit demand, providing greater justification for rail connection.

Airport Site Visits

On-site investigations of recent innovations at a variety of airports were conducted in the United States, Europe, and Asia. The focus of these investigations was to identify innovative methods for processing passengers. Innovations noted at Heathrow, Munich, Vienna International, and Hong Kong International airports are discussed below. London Stansted, London Gatwick, and San Francisco International airports were also visited to gain insight on specific topics, such as low-cost carrier operations (London Stansted) and the two-step check-in process (London Gatwick) in Europe and remote baggage check in the United States (San Francisco International). While examination of the processes in place at these latter airports was beneficial to development of the innovations described in Chapter 4, more focus in this report is placed on the former airports as they provide examples of both facility and processing innovations.

Terminal 5 at Heathrow Airport

Heathrow's Terminal 5 opened in March 2008. Two innovations at Terminal 5 that are pertinent to this research effort are the departures hall check-in process and the multifunctional close-in parking garage. The check-in process was designed assuming that 80% of passengers either would proceed directly to the SSCP (i.e., those passengers who checked in via the Internet or remote self-service kiosk and do not have check baggage); would check in using self-service kiosks (i.e., those passengers who need a boarding pass only) and then proceed immediately to the SSCP; or would deposit check baggage at a baggage drop and then proceed to the SSCP. The remaining 20% of passengers were assumed to use full-service

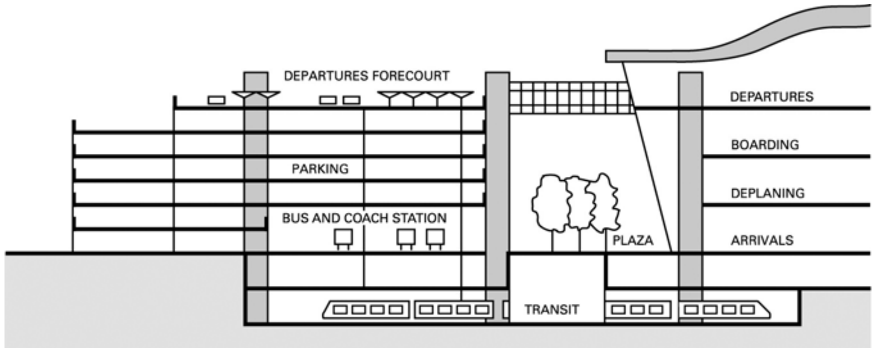

Figure 2-1. Heathrow Terminal 5 conceptual section.

agent positions to obtain the necessary travel documents or check baggage. The full-service positions are located on the perimeter of the departures hall to encourage passengers to use the more prominently located self-service functions.

The multifunctional parking garage (see Figure 2-1) includes a departures forecourt rather than traditional linear curbs located on different levels directly adjacent to the terminal building, as well as an intermodal station for rail service serving the airport, surrounding communities, and the city of London. The garage is separated from the terminal by a pedestrian plaza, which enhances the transition between the terminal and the garage and minimizes at-grade pedestrian crossings of roadways.

Munich Airport

Munich Airport exhibits several innovations relevant to this research effort. The transit station for rail service between the city and the airport is located between the two passenger terminals and can be accessed via pedestrian routes from either terminal without crossing the roadways (see Figure 2-2). Above the transit station is a central terminal (landside only), which provides self-service check-in devices adjacent to the exit from the station platform; it also provides a remote check-in hall, which is staffed by agents, and has self-service baggage check capability. A further innovation is the use of four large forecourts on either side of Terminal 2 in lieu of conventional curbs. On one side of the terminal, two levels are provided for POV passengers—departures on the upper level and arrivals on the lower level. On the other side of the terminal is a similar arrangement for CV passengers. The area immediately in front of Terminal 2 is a pedestrian plaza.

Munich Airport has a very large covered area between the two terminals, referred to as the Munich Airport Center, which is used for large public events and contains commercial functions. The center serves to publicize the airport and generate greater use of the regional transit system serving the airport.

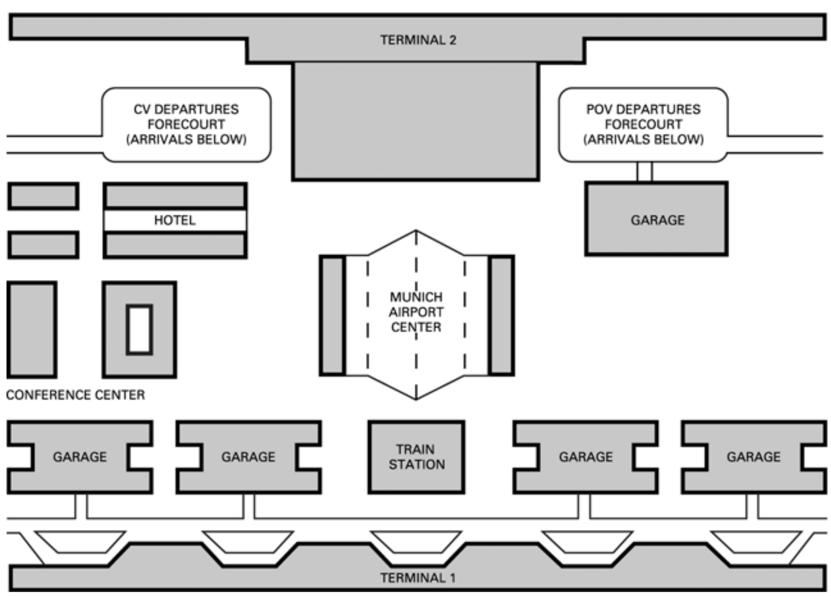

Figure 2-2. Munich Airport conceptual site plan.

Vienna International Airport

One key innovation related to Vienna International Airport is the City Airport Terminal located in the Vienna City Center, which provides remote check-in facilities via SSDs, with self-service baggage check and full-service agent positions (see Figures 2-3 and 2-4). The City Airport Terminal allows passengers to obtain boarding passes and check baggage using either self-service devices or full-service agents. Baggage must be checked at least 90 min prior to departure and is transported to the airport on the same train as the passengers. The baggage is off-loaded at the airport and inserted into the baggage-handling system directly for screening and delivery to the aircraft.

Vienna International Airport was one of the first European airports where self-service baggage check was implemented (see Figure 2-5). Boarding-pass-only SSDs are located in front of the ticket counters. Passengers who check in via the Internet can proceed directly to the bag-drop-only counter positions and check their baggage with an agent. Passengers can also use the self-service baggage check-in positions. Airline personnel are strategically positioned throughout the check-in hall to encourage the use of self-service devices and to assist passengers as necessary.

Hong Kong International Airport

An innovative approach used at Hong Kong International Airport to manage terminal curbside congestion involves the relocation of all private vehicle pickup/drop-off activity to auxiliary curbside areas within the terminal parking facilities.

Figure 2-3. Vienna City Airport terminal—exterior. Source: Corgan Associates, Inc.

Figure 2-4. Vienna City Airport terminal—interior. Source: Corgan Associates, Inc.

These curbside areas, located in the parking areas on both ends of the terminal, provide convenient access to the terminal building and prevent the addition of private vehicle traffic on the main terminal curbside roadways. As the taxicab curbsides are not directly adjacent to the terminal building, less security-related enforcement is required and drivers often opt to use immediately adjacent short-term parking spaces rather than dwell excessively at the auxiliary curb.

The innovations described above serve as the foundation for developing innovations that address the common issues faced by passengers at airports in the United States. Since the U.S. airport operating environment is different from that at airports in Europe or Asia (higher level of POV activity, availability of curbside check-in, etc.), the innovations at those airports have been adapted to better suit U.S. airports. References to those airports are made throughout this report to provide examples of similar applications of each innovation.

Figure 2-5. Self-service baggage check at Vienna International Airport. Source: Corgan Associates, Inc.

CHAPTER 3

Approach to Developing New Concepts

The approach to developing new concepts began with examining passengers' experiences as they proceed through an airport's landside facilities and terminal processes and then developing ways to improve that experience through new terminal landside facility concepts. The main components of this approach included the following:

- Identifying key passenger processes related to terminal landside facilities;
- Establishing the issues, or problems, that passengers commonly face in those processes;
- Identifying innovations to address the issues passenger commonly face;
- Developing concepts incorporating those innovations; and
- Evaluating the new concepts.

The research team began by identifying the key processes that passengers typically experience at an airport while either leaving on a flight or returning from one. From the research described in Chapter 2, a number of issues that passengers commonly encounter was identified. One or more of these issues may be encountered in any of the passenger processes—for example, the inconvenience of waiting may be encountered when checking baggage, obtaining a boarding pass, retrieving baggage, using a shuttle bus, or during any other process.

Innovations that are currently in use or being developed at airports around the world were identified based on their potential for mitigating these common passenger issues and improving levels of service. These innovations are described in Chapter 4. The innovations were then incorporated into terminal landside planning concepts to determine how they might work in practice and their potential effects on future terminal landside planning. Chapters 5 and 6 describe and present a number of alternative concepts for the landside and terminal processes, respectively.

The process for evaluating the innovative concepts, from the perspectives of passenger processes and airport operations, is presented at the end of this chapter, and the evaluations are included with the discussions of each innovation and concept to assist the operators of large- and medium-hub airports, the airlines serving those airports, and landside and terminal planners in evaluating the applicability of specific innovations or concepts to their airports. The components of the approach used in this research project are described below.

Passenger Processes

Identifying the key processes that passengers experience after they enter the airport (whether arriving by private vehicle or other form of ground transportation) is central to the development of innovative solutions to common issues/problems. Because the layout of landside facilities at each airport is unique, it is important to focus on the similarities, which are the processes.

The process flow diagrams show the paths of passengers arriving at an airport and proceeding to the SSCP (see Figure 3-1) and subsequently leaving the secure area of the airport and proceeding to the airport exit (see Figure 3-2). The lines connecting the various activity points indicate that the activity relates to roadway traffic, pedestrian movement, or high-occupancy vehicles.

The two overall process flows described can be separated into a number of more specific flows that have their own characteristics. The following process flows are discussed in the next sections:

- Airport entrance to remote parking and on to terminal drop-off,
- Airport entrance to private vehicle curb,
- Passenger drop-off to SSCP,
- Close-in parking to SSCP,

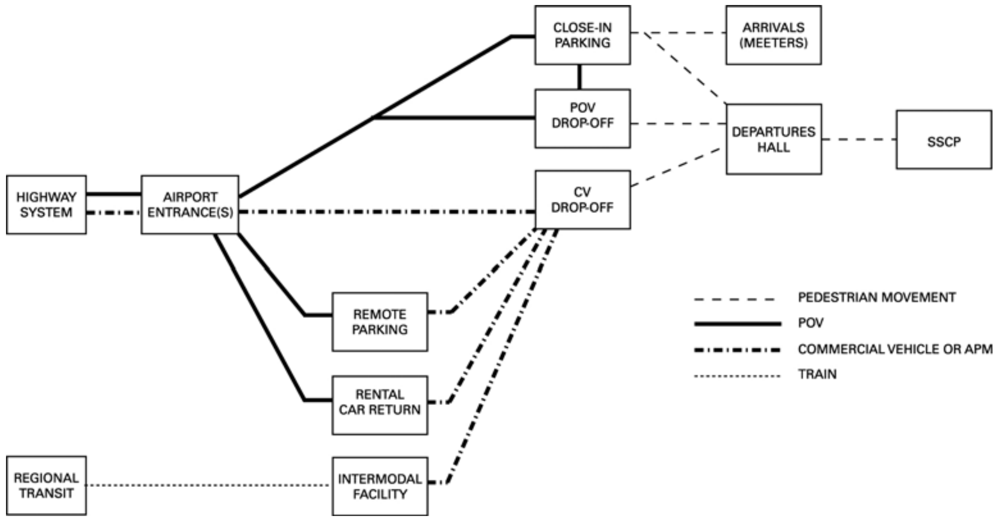

Figure 3-1. Arriving at the airport.

- Transit system to terminal entry,
- Secure area to close-in parking,
- Secure area to commercial vehicle pickup, and
- Commercial vehicle pickup to remote parking and on to airport exit.

Airport Entrance to Remote Parking and on to Terminal Drop-Off

Many larger airports offer multiple options for remote parking that are in geographically different parts of the airport and that require different travel routes to access the facilities. Once a passenger has parked his or her vehicle in the remote facility, the challenge, particularly for the elderly, shifts to finding and walking to the designated airport shuttle stop and then boarding the vehicle that will transport the passenger to the terminal building. In using the remote parking facilities, the passenger is often confronted with additional stress resulting from a lack of information pertaining to arrival time for the shuttle and the amount of time it will take the shuttle to travel to the terminal.

Airport Entrance to Private Vehicle Curb

One of the most heavily traveled routes on airport roadways is the route that private vehicles take to access the arrivals-level curbside to pick up arriving passengers. The heavy traffic volumes associated with this process, as well as unclear roadway signage, can make this seemingly simple process one of the most stressful. Adding to the stress of this process are late

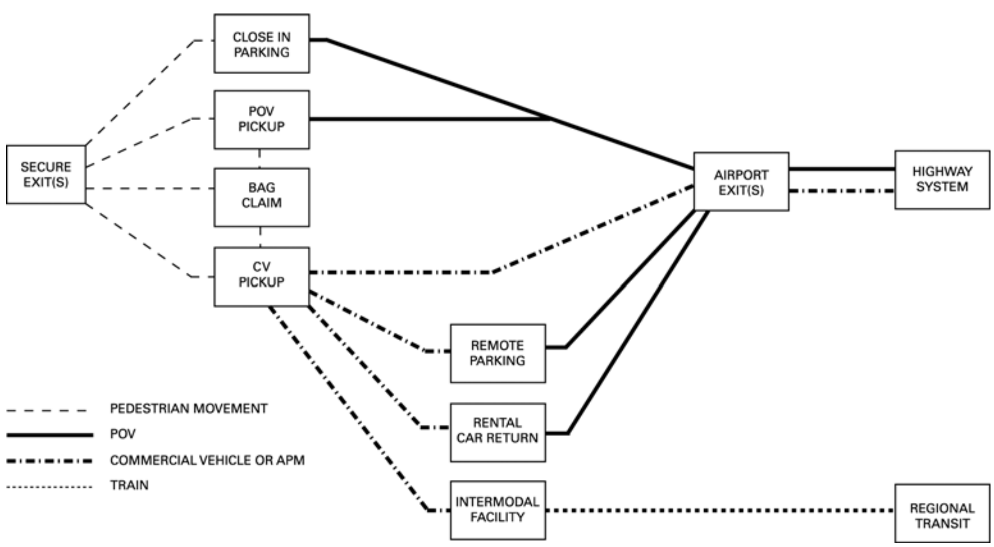

Figure 3-2. Leaving the airport.

arriving flights combined with drivers not knowing when or where they need to pick up their passengers.

Passenger Drop-Off to SSCP

Passengers being dropped off at the terminal curb via private vehicle or taxicab have several choices. If they have check baggage, they can either use curbside check-in or proceed to the departures hall where myriad options are available, ranging from self-service check-in and staffed bag-drop positions to full-service ticketing. Passengers without baggage can proceed directly to the SSCP if they obtained a boarding pass over the Internet or if they used a self-service check-in kiosk or the full-service counter. With the proliferation of the use of self-service check-in and check-in over the Internet options, strong potential exists to improve the level of service related to this particular process.

Close-In Parking to SSCP

Passengers using the airport's close-in parking facilities experience many of the same processes as those being dropped off at the private vehicle or taxicab curbsides, except that close-in parkers must transport their baggage farther, between parked cars, and often through more vertical transitions, and they potentially have to cross the terminal roadway via an at-grade crossing. Once inside the terminal, the processes and check-in/bag drop processes are the same. The focus in this process is on passengers with check baggage rather than those without check baggage who can proceed directly to the SSCP or use self-service check-in kiosks.

Transit System to Terminal Entry

At airports that offer a connection to a local transit system, the transit system is often not directly integrated with the terminal building. At those airports with fully integrated rail systems, a higher level of customer convenience can be provided by reducing the need for mode changes and long walking distances. Typically passenger walking distances, multiple vertical transitions, the need for multiple mode changes, limited service times that may not correlate with airport peak periods, and unreliable connection times from the transit system to the terminal via an airport train or shuttle bus system are some of the issues associated with this process.

Secure Area to Close-In Parking

Passengers who must retrieve checked baggage and who have parked in the close-in parking facility face the additional burden of transporting their baggage from the bag claim device to their vehicle, which often involves numerous vertical transitions. In addition, the pedestrian paths to the close-in parking facilities typically involve at-grade crossings that require passengers to transport their baggage across a busy arrivals roadway. At airports where close-in parking is provided in a garage, passengers with baggage may experience heightened levels of concern for their personal safety because garages are often poorly lit and typically not heavily populated.

Secure Area to Commercial Vehicle Pickup

A process that has historically been less emphasized during design is that of passengers leaving the secure area of the terminal and proceeding to the commercial vehicle pickup area. In particular, passengers who must claim checked baggage are often faced with the challenge of finding the proper bag-claim device and then navigating a complex path to the desired commercial service vehicle pickup area. Once passengers arrive at the appropriate pickup area, typically no information is available regarding how long the wait will be for the next shuttle, bus, or taxicab, nor are any amenities provided such as information displays, sheltered waiting areas, or restrooms that can be used while they wait.

Commercial Vehicle Pickup to Remote Parking and on to Airport Exit

After exiting the terminal building, passengers require directions to the vehicle boarding area for their desired mode of travel to exit the airport such as parking shuttle bus, door-to-door shuttles, or other people-mover system either adjacent to the terminal building or at an outer curbside island accessed via at-grade crosswalks. Several airports offer commercial vehicle pickup at remote curbside areas or in an adjacent parking garage. Once arriving at their desired vehicle boarding area, passengers may also experience additional stress resulting from the lack of information regarding shuttle vehicle arrival times or unclear directions as to which vehicle to board. Upon reaching the remote parking area, passengers must offload their baggage, walk to their vehicle, load the vehicle, and then travel to the exit plaza. At the exit plaza, the driver is often presented with the option to exit either via prepaid lanes or via a cashier-staffed lane.

Issues Passengers Commonly Face

For each of the processes described above, passengers may face one or more issues that affect their travel experiences and increase their stress level. The issues passengers most commonly face were identified through the research described in Chapter 2, as well as from input from the ACRP project panel and the combined experience of the research team. These common issues were divided into several broad categories, as follows:

- Waiting/queuing,
- Walking/vertical transitions,
- Baggage handling by passengers,
- Information/signage/wayfinding,
- Vehicular movement/pickup/drop-off, and
- Safety and security.

Table 3-1 presents a summary of the issues commonly found in each process. Each category is discussed below.

Waiting/Queuing

A major cause of anxiety and frustration for the airline passenger is the inevitability of having to wait in line, often multiple times. Passengers are often frustrated by the perceived waste of time and are anxious about the possibility of missing their flight, especially in light of the uncertainty related to possible further queuing. In addition, waiting in line generally requires long periods of time standing, which can be fatiguing, particularly for the elderly. This experience is further aggravated by boredom resulting from a lack of mental stimulation and real-time information regarding their trip. From an operating efficiency standpoint, large building areas are often required just to accommodate the nonproductive activity of queuing.

Walking/Vertical Transitions

Walking distances are generally not as significant an issue on the landside of terminal buildings as they are on the airside. The longest walking distances on the landside are typically in large parking lots or garages where the routes may be not only long, but also indirect, and moving sidewalks may not be available. More commonly, passengers are inconvenienced by changes in levels along the path. In addition to staircases, escalators provide the primary means of assistance, with elevators provided where required by accessibility laws. Unfortunately, the elderly and the disabled, as well as families with small children and those with baggage carts, are often reluctant to use escalators because of the challenge of getting on and off with their baggage. Compounding this issue is the fact that elevators are often not provided on the passengers' direct route of travel and, therefore, may be difficult to find. Also, elevators are frequently inadequately sized and are insufficient in number to provide adequate service, especially at peak periods.

Baggage Handling by Passengers

Transporting baggage presents major problems for passengers. Issues include potentially long walks that may require negotiating level changes, lifting bags onto bag wells at ticket counters, and lifting bags off bag-claim devices. At most U.S. airports, baggage carts are not freely available, and elderly passengers often require assistance lifting and transporting their baggage, which also may not be available.

Information/Signage/Wayfinding

Airports are complex environments. In well-designed facilities, wayfinding can be somewhat intuitive; however, most passengers rely on signage and other information sources to find their way. One concern is the clarity of signage, with font sizes often being too small for easy readability, especially for the elderly and those with special needs. Informational signage often competes with commercial signage and advertising and includes terminology and symbols that may be understood by airport planners, but not necessarily by the

Table 3-1. Issues commonly found in each key process.

	Issues					
Key Processes	Waiting / Queuing	Walking / Vertical Transitions	Baggage Handling by Passengers	Information / Signage / Wayfinding	Vehicular Movement / Pickup / Drop-off	Safety and Security
Ticketing/check-in	●	○	●	●	—	○
Close-in parking to departures hall	—	●	●	●	—	●
POV drop-off at terminal curb	○	○	●	●	●	●
CV drop-off at terminal curb	●	●	●	○	●	○
Arrivals hall to POV pickup	—	○	●	●	●	○
Arrivals hall to CV pickup	—	●	●	○	●	●
Arrivals hall to close-in parking	—	●	●	●	●	●
Transit system to terminal	—	●	●	●	○	○

● Issue is a significant concern
○ Issue is present but not a significant concern
— Issue is not a concern

general public, including those who do not speak the local language. Informational displays are often not interactive and the lack of real-time information can cause anxiety. Wayfinding can also be difficult because of confusing indirect routes with multiple decision points along the way. This confusion can be exacerbated by the conflicting priorities of passenger movements and the goals of retail establishments.

Vehicular Movement/Pickup/Drop-Off

The constant movement of POVs and CVs on the airport terminal roadway system is another contributor to passenger stress. Accommodating all of these mode types within the limited roadway and curbside capacity that is typically available at airports can result in a number of issues. For example, vehicles typically cluster around desirable curbside locations, such as doorways and skycap areas, resulting in congestion hot spots. Curbside congestion increases the potential for queuing that can extend onto the airport access roadway system and impede overall access to the airport. The double parking often associated with checking baggage at the curbside creates safety issues and exacerbates curbside congestion, which further reduces the capacity of the roadway system. On the arrivals level, a balanced level of enforcement must be achieved. Very high levels of enforcement, which keep the arrivals level roadway freely flowing, may contribute to secondary effects of increased recirculating traffic and increased staffing costs to the airport operator. Other factors, such as short merging distances and vehicles backing up at the terminal entrances, also reduce roadway capacity.

Safety and Security

Passenger anxiety is increased by real and perceived safety concerns. These concerns can include the very real possibility of traffic accidents caused by roadway congestion and pedestrian injuries related to at-grade roadway crossings, typically between the garage and the terminal building. Passengers may also be concerned about personal safety in parking garages and at transit stations and even at the curbside, especially late at night. The concentration of unscreened check bags in the departures hall, at curbside check-in, or at a remote check-in location may also be perceived as a safety threat.

Innovations Identified

During the research phase, several innovations were identified to improve the passenger's airport experience. These innovations included procedural methods as well as physical devices. Some of the innovations are not, by themselves, new, but the manner in which they have been combined may be. For example, while CUSS systems are currently being implemented, the concept of arranging the entire departures hall based on passenger check-in processes (i.e., boarding pass only, boarding pass and baggage check, or full-service check-in) is not currently being implemented. The following is a brief summary of the innovations that are described in detail in Chapter 4:

- Leveraging CUSS kiosks to differentiate passenger-processing activities according to individual passenger requirements;
- Developing passenger-processing facilities that accommodate a variety of functions at locations other than the conventional terminal building;
- Providing the capability for passengers to tag their own check baggage using automated devices at a variety of locations both inside and outside the terminal building;
- Providing alternative means for dropping off passengers, picking up passengers, and short-term parking for passengers traveling in private vehicles;
- Implementing alternative methods of accommodating commercial vehicle operations in lieu of the conventional curbside;
- Providing special facilities provisions for accommodating the increasing number of elderly travelers, including baggage devices, vertical transportation systems, and seating; and
- Implementing techniques for enhancing the passenger's arrival experience, including meeters and greeters and the interface with ground transportation.

Concepts Incorporating Innovations

One of the major goals of this research project was not only to identify innovations, but also to understand and evaluate their potential effects on airport terminal landside facility planning and design. Therefore, several new landside (see Chapter 5) and terminal (see Chapter 6) concepts that incorporate one or more innovations were developed.

The landside concepts are based on the passenger processes described earlier and include activities from the beginning of the passenger's journey to the point where the passenger enters the terminal building and the reverse. These concepts encompass POV and CV traffic, remote baggage check, parking, passenger drop-off and pickup, and the potential integration of regional transit systems and rental car facilities. The process of picking up and dropping off passengers was examined through innovative alternatives to the conventional curbside. The terminal concepts incorporate a number of different check-in arrangements and arrivals concepts, which include an idealized arrangement of components related to domestic arrivals, including meeters and greeters, baggage claim, and the ground transportation interface.

The concepts have been developed in some detail in an attempt to verify their practicality and workability; however, it should be noted that the illustrations and descriptions are not intended to represent specific design solutions.

Evaluation Process

The innovations identified and the concepts incorporating those innovations, as described in Chapters 4 through 6, were evaluated by examining the advantages and disadvantages of each and then comparing each with other innovations or concepts, as appropriate. The advantages and disadvantages of each innovation and concept are discussed after the descriptions of the innovation and concept. The intent is to provide valuable information to enable airport management, other stakeholders, and terminal landside planners to determine whether a specific innovation or concept applies to their specific situation. In addition to the advantages and disadvantages of each innovation or concept, the potential challenges to implementation are also discussed.

The information provided in the evaluations of the innovations and concepts was based on the experience of the research team as well as comments on the innovations and preliminary innovative concepts collected during on-site workshops held with airport management representatives—including senior executives, planning and development, engineering, operations, and public safety—as well as airline representatives.

Simulation analyses were conducted for select options to provide preliminary insight into their potential benefits or constraints. The simulation analyses were based on existing datasets of actual U.S. airports so that realistic estimates of the facility requirements could be obtained. Brief descriptions of the simulation results are provided with the appropriate concepts; full descriptions of the simulation models used are provided in the appendix.

CHAPTER 4

Innovations

The innovations developed through this research effort are a combination of existing approaches that have not been widely implemented and of new methods for improving the passengers' experience and enhancing operational efficiency. Many of the innovations are intended to improve the airport experience not only for the average passenger, but also for the aging population, which is becoming an increasingly important consideration for airport operators and planners. The innovations involve approaches that could be implemented immediately, as well as some that may require government approval of certain activities, such as self-tagging of check baggage. All of the innovations incorporate methods, approaches, or activities that are being implemented in some form at various airports throughout the world.

The innovations are intended to serve as a "kit of parts" for developing new concepts incorporating one or more innovations (see Chapters 5 and 6). Through this approach, airport stakeholders will be able to evaluate the innovations based on their need to address specific issues and will also be able to consider how multiple innovations could be combined to enhance the overall passenger experience rather than addressing a single issue. Because each airport terminal landside is unique in its operation and physical layout, emphasis is given to the innovations as methods to address issues passengers commonly face rather than prescribing specific solutions that may or may not be adaptable to a given airport's terminal landside facilities. The intent is to ensure that the innovations are relevant to a wide variety of situations and airport sizes.

Each innovation is examined in detail in this chapter. The assumptions upon which each innovation is based or prerequisite conditions that are needed to make the innovation feasible are identified. The advantages and disadvantages, from both the passenger and airport operations perspectives, are discussed, along with any challenges to implementation. The innovations identified involve the following:

- Process-based departures hall,
- Passenger-processing facilities,
- Self-service baggage check,
- Bag-check plaza,
- Supplemental curbsides,
- Passenger assistance parking area,
- Low-profile passenger baggage devices,
- High-capacity flow-through elevators,
- Consolidated meeters-and-greeters area, and
- Arrivals lounges

Process-Based Departures Hall

The process-based departures hall layout shown in Figure 4-1 is based on the realization that common-use terminal equipment (CUTE) not only allows for the sharing of equipment, but could also affect the layout of the departures hall and corresponding curbside. In a traditional departures hall serving multiple airlines (see Figure 4-1: "Multiple Airlines"), each airline has its own proprietary equipment at the ticket counters, as well as its own SSDs. The curbside usually reflects the location and extent of the ticket counter frontage of the individual airlines. At airports where CUTE is used in the departures hall, each airline is typically assigned a number of "exclusive-use" ticket counter positions and has the ability to use other "shared" positions as their passenger demand requires. Many of these airports provide CUSS kiosks where passengers can check-in for multiple airlines. The curbside signage at these airports usually reflects the locations of the individual airlines.

In contrast, a process-based departures hall could be separated according to passenger check-in processes rather than by airline (see Figure 4-1: "Process-based"). Using CUTE (including CUSS), the departures hall could be arranged into three sections: (1) self-service devices where passengers can print boarding passes, change seat assignments, request upgrades, etc.; (2) a self-service baggage check area where passengers can use SSDs to obtain bag tags and deposit their check baggage into the baggage handling system; and (3) full-service airline-staffed positions for passengers who

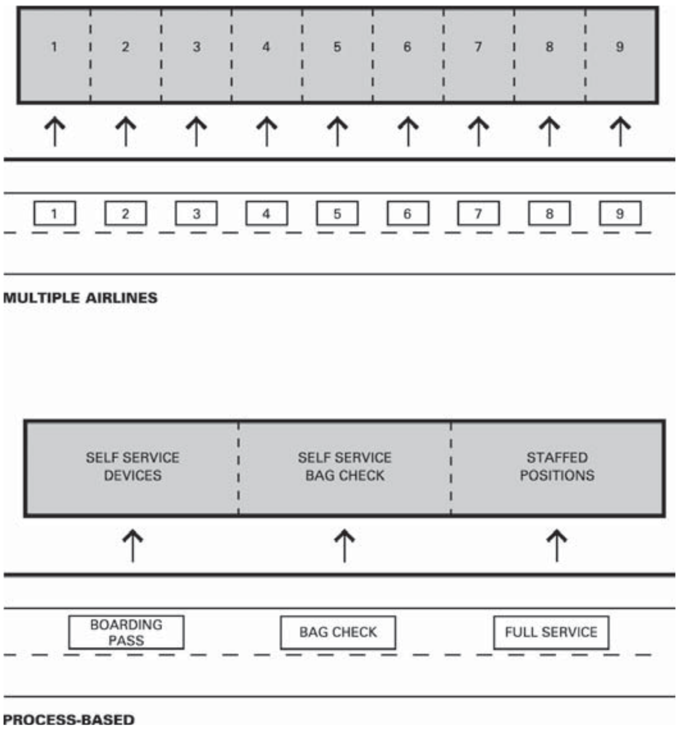

Figure 4-1. Process-based departures hall.

need (e.g., elderly/disabled or displaced passengers) or desire (e.g., premium passengers) interaction with an airline agent. The terminal curbside would also be arranged and signed to match this layout.

Key Drivers

While the ability to "share" may indeed reduce the need for additional ticket counter positions, "exclusive-use" positions require the departures hall and corresponding terminal curbside to be arranged by airline. This arrangement often results in inefficient use of the entire departures hall as can be seen at many airports where a long queue forms in front of one airline's counters and nobody is standing in front of adjacent airline counters. The same is true at the curbside. The disproportionate length of curbside assigned to a particular airline related to the amount of traffic on that airline causes curbside congestion, especially during peak periods. However, because of airline-specific signage at the terminal curbside, passengers are often not inclined to travel farther down the curbside to a less-congested area. The result is the same inside the terminal where one area has a concentration of passengers and the adjacent areas are practically vacant. With the increasing costs of terminal facility expansion and the complexity of implementing major renovation or new construction projects in or around an operating terminal, the need for higher utilization of existing facilities is greater than ever.

Examples

The process-based departures hall layout is not currently implemented at airport terminals serving multiple airlines regardless of whether CUTE is being used. However, single airline terminals—commonly airline hubs—are often split into zones based on the type of service (premium/first-class, domestic, international, etc.), but not necessarily on the passengers' check-in processes (boarding pass, baggage check, or full-service). Having only one airline tenant in a terminal promotes this type of separation because differentiation among airlines is not required. The curbside at these terminals typically reflects the same zones as the departures hall.

Assumptions/Prerequisites

Implementation of the process-based departures hall layout requires that one major component be in place. Each terminal must have a single baggage-screening system with a sortation system downstream of the screening matrix that feeds to individual airline outbound baggage makeup devices (or a common baggage makeup room). If a centralized baggage screening system is not in place, the departures hall cannot be separated based on passenger check-in processes because each ticket counter baggage take-away belt would feed to individual screening systems and then require sorting or manual transportation to the proper airline, defeating the efficiencies of a common-use process and equipment.

The ideal process-based departures hall layout is based on the assumption that passengers will be allowed to tag their own check baggage. This self-tagging would allow for all of the SSDs (boarding pass and baggage check) to be attended by roving agents rather than requiring staffed agent positions for accepting check baggage. Another assumption is that, since multiple airlines would be sharing SSDs, either the airport operator or a third-party would provide the roving agents to support these SSDs. The cost of these agents could be split among the participating airlines.

Evaluation

Passenger Perspective

The process-based departures hall addresses a number of the issues that passengers commonly face. First, waiting and queuing would be improved because passengers would be able to check in and check baggage at a number of locations, a common benefit with current common-use facilities, rather than at specific airline facilities. By combining the self-service processes (boarding pass and bag check) for all airlines in the terminal, passenger traffic would be more constant, particularly during nonpeak periods when some airlines are very busy and others are not. The aggregate passenger demand would require fewer check-in positions with a process-based departures hall than with a traditional layout, allowing for the capacity of the departures hall to be increased without expanding the facility.

Improved wayfinding would be another important advantage of the process-based departures hall, in both the departures hall and at the terminal curbside. Often, passengers are confused by the excessive signage required to direct the passengers of multiple airlines to their respective areas. The process-based departures hall would only require signage directing passengers to the three functional areas so that they would not have to distinguish the airline they want from a vast array of airline-based signage. Another advantage is that the departures hall could be organized so that a passenger who only needs to use an SSD could be processed near the SSCP, whereas the same passenger in a multiple-airline arrangement may have to pass numerous other airline counters on their way to the SSCP.

The biggest disadvantage of the process-based departures hall layout is that passengers would be required to adapt to a new way of thinking about processing in the departures hall. Rather than simply looking for their airline, passengers would have to understand their processing needs. However, it is not unrealistic to expect passengers to understand their processing needs because the increasing numbers of passengers using self-service functions is an indication that they know what their processing needs are—that is, passengers understand that they need only a boarding pass if they are not checking baggage or that they need to stop in the departures hall to deposit their check baggage.

Operations Perspective

One major advantage of the process-based departures hall over the traditional multiple-airline departures hall is the increased operational efficiency during nonpeak periods. At most airports, although passenger traffic is lower during nonpeak periods, the aggregate traffic flow is relatively constant. However, the traffic for any given airline might vary dramatically throughout the day, causing periods of either severe congestion or relative inactivity. This effect also affects the curbside. As the process-based departures hall combines passenger traffic for all airlines, operational efficiency in the departures hall and at curbside would increase because the amount of check-in equipment or curbside frontage required would be based on total traffic rather than on the traffic of an individual airline. The result is that curbside demand can be balanced with departures hall demand, which is not possible with the traditional multiple-airline arrangement where the curb frontage for each airline is commonly based on the length of ticket counter frontage and not the amount of vehicle traffic associated with that airline.

Another advantage of the process-based departures hall, especially for airport operators, is that the terminal flexibility is enhanced by the separation of functions by passenger check-in processes rather than by airline. The only portion of the process-based departures hall that would be affected by airline changes would be the full-service area, and a large amount of flexibility would even be maintained there because it would be sized based on aggregate demand and not necessarily by individual airline requirements. This flexibility would greatly reduce the number of signage changes or cosmetic changes commonly associated with traditional multiple-airline terminals.

With a traditional terminal, the airline's position within the departures hall or on the terminal curbside can be an advantage if the airline is able to provide a more convenient route to the SSCP. The process-based departures hall minimizes the potential for an individual airline to have an advantage because all of the self-service functions would be located together and the full-service functions would be located together.

Simulation Analyses

Initial simulation analyses of the process-based departures hall showed a significant reduction in the required number of check-in positions compared with today's requirements where each airline operates its own check-in equipment. A simulation analysis was conducted at a terminal section with three legacy carriers serving just fewer than 2 million annual enplaned passengers and approximately 560 peak-hour originating passengers. At this size airport or terminal, from which several airlines operate with similar peak times, little reduction in the SSD requirements resulted; however, a 45% savings in the number of full-service check-in positions required did result.

Another analysis was conducted for an airport terminal serving just fewer than 7 million annual enplaned passengers by seven airlines, one of which accounted for nearly half of the enplaned passenger traffic. This facility processed nearly 2,100 originating passengers in the peak hour. As airline peak hours do not exactly coincide, a process-based departures hall would require fewer positions for each check-in process—40% fewer full-service check-in positions and at least 30% fewer self-service check-in devices. Detailed results of these analyses are included in the appendix.

Challenges to Implementation

A significant challenge to implementation of a process-based departures hall is the need for a common baggage-screening system with a sortation system downstream of the screening matrix that directs bags to an individual airline's or multiple airlines' outbound baggage make-up devices. While this type of system is more common post-September 11, 2001, many airports have either zoned baggage-screening systems or individual screening systems.

Another major challenge to implementation of a process-based departures hall is that airlines typically view their branding as an important part of their ability to differentiate themselves from other airlines. The process-based departures hall limits opportunities for branding to the full-service counters, which accommodate only 20% of originating passengers, and the airline-specific portion of the SSD software. However, the operational efficiencies associated with the process-based departures hall may cause the airlines to strongly consider the trade-off between reducing costs and maintaining brand identity at the terminal landside facilities.

Passenger-Processing Facilities

The innovations identified regarding passenger-processing facilities address the fundamental issue that expansion or major renovation of terminal landside facilities is very expensive and often has a significant impact on operations. One option for delaying more expensive capital projects is to relocate some of the major passenger-processing functions commonly located in airport terminal landside facilities such as check-in, baggage check, and curbside operations or to combine the facilities with complementary facilities such as close-in parking. These multifunctional passenger-processing facilities (see Figure 4-2) could be located adjacent to an existing terminal, within the airport but remote from the central terminal area or remote from the airport near a major population center, such as a central business district or urban shopping center.

The passenger-processing facilities in all three configurations shown in Figure 4-2 would be connected to the existing terminal in different ways. An adjacent passenger-processing facility (APPF) would be connected to the existing terminal via a pedestrian link such as a sky bridge with moving sidewalks. The on-airport passenger-processing facility (OPPF) could be connected to the terminal via some form of people mover such as an APM. The remote passenger-processing facility (RPPF) could be integrated with a regional transit system that connects to the airport or could be a collection point for the regional transit system with a dedicated connection to the central terminal area via busing operations or an APM. The APPF and OPPF could also serve as collection points for other on-airport ground transportation functions such as remote parking, off-airport transit, and rental car operations.

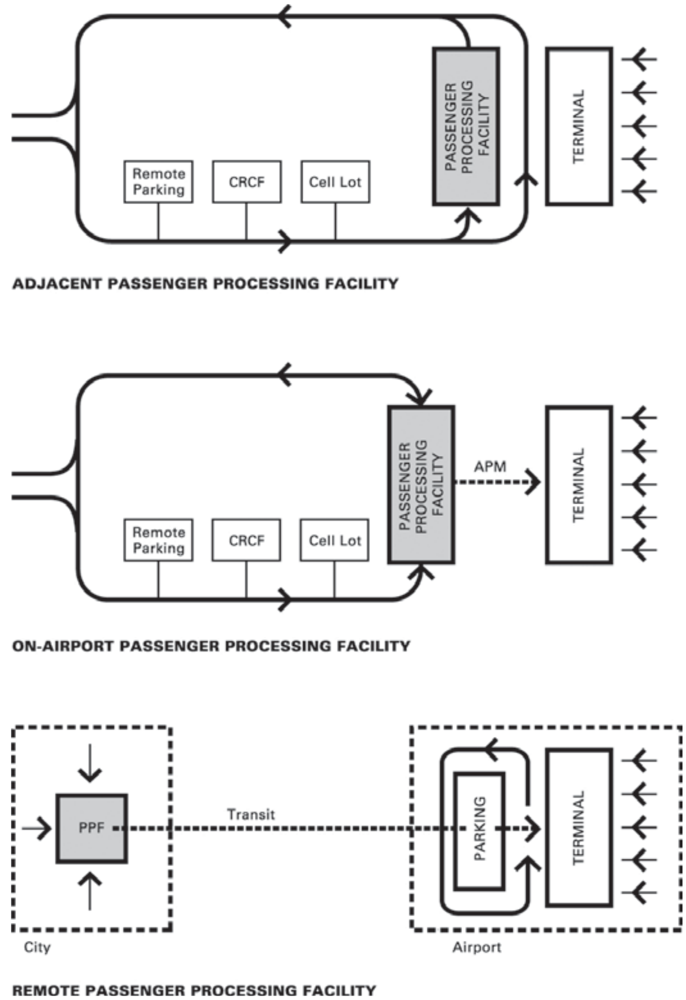

Figure 4-2. Passenger-processing facilities.

Key Drivers

The key driving force behind developing passenger-processing facilities that accommodate a variety of functions at locations other than the conventional terminal building is to delay major capital projects required to expand the capacity of an existing terminal; this innovation may be less complex and therefore less expensive to construct. The combination of these major functions with other related functions, such as POV curbside operations, should provide additional capacity and increase the level of service for passengers in a more cost-effective manner than expanding an existing terminal and associated landside facilities.

Examples

Similar facilities have been implemented at a variety of airports in the United States, as well as in other countries. San Francisco International Airport and Chicago's O'Hare International Airport offer check-in and baggage check at on-airport remote parking locations. Some airports, such as Hartsfield Jackson Atlanta International, offer curbside check-in (using skycaps) in the close-in parking garage. The close-in parking garage at Heathrow Airport's new Terminal 5 (see Figure 2-1) combines a number of passenger-processing functions, such as POV and CV curbside operations, parking, and regional transit. Munich Airport provides check-in and baggage check within the train station located between the two terminals (see Figure 2-2), which is combined with the rental car counters and the regional transit system. Vienna International Airport has a remote terminal (City Airport Terminal) located in downtown Vienna, which is connected to the regional transit system and has a dedicated rail link to the airport. The remote terminal offers both check-in and baggage check (see Figures 2-3 and 2-4), with the checked bags transported to the airport in secure sections of the rail cars. Hong Kong International Airport offers check-in and baggage transportation assistance (which is fee based) at the Hong Kong and Kowloon train stations located on the Airport Express dedicated railway. The Airport Express station at the airport is located in the Ground Transportation Centre, which also accommodates multiple local and regional bus services.

Assumptions/Prerequisites

The feasibility of such innovative passenger-processing facilities relies heavily on the key assumption that passengers would be able to tag their own check baggage. Without this ability, passenger check-in would still be available via SSDs, but checking baggage would require airline agent support or relocation of the existing curbside check-in operations. In addition, common baggage screening systems for each terminal would greatly increase the viability of innovative passenger-processing facilities, as passengers from any airline operating within each terminal would be able to use the check-in or baggage check services located within the passenger-processing facility. For the APPF and OPPF, the existence of adequate close-in parking at the airport may reduce the added benefit of either type of passenger-processing facility as parking is a key element of both innovative facilities. However, if the airport needs to add parking or the close-in parking garage is in need of major reconstruction, either the APPF or OPPF would be a good alternative. The RPPF concept was examined in detail in ACRP Project 10-02, "Planning Guide for Offsite Terminals."

Evaluation

Passenger Perspective

Passenger-processing facilities that accommodate a variety of functions at locations other than the conventional terminal building have the potential to address a number of the issues that passengers commonly face. The ability to check in and check baggage in proximity to parking relieves passengers of the need to transport their baggage from a close-in or remote parking garage to the terminal before the bags can be checked. This process would be especially beneficial to the elderly and those with disabilities. Another advantage of this innovation is that wayfinding within the terminal landside could be simplified by directing passengers to a passenger-processing facility that serves multiple terminals or a single terminal with multiple airlines rather than directing them to various positions along the terminal curbside for a specific airline. Vertical transitions could also be minimized in a passenger-processing facility by locating all curbside operations on one level compared with many terminals with multilevel roadway systems. Consolidated passenger-processing facilities, particularly APPFs and OPPFs, would also help alleviate some of the congestion commonly experienced on the terminal roadway resulting from curbside check-in competing with passenger drop-off and recirculating traffic. Finally, consolidated passenger-processing facilities could reduce or eliminate at-grade crossings by providing for the delivery of passengers directly into the terminal building.

One of the main disadvantages of such innovative passenger-processing facilities is that the functions currently provided adjacent to the terminal building, such as curbside check-in and private or commercial vehicle drop-off/pickup, would be relocated to facilities farther away from the terminal, creating the perception of a lower level of service. However, for the OPPF, the use of automated transit systems versus busing operations to connect passengers between the passenger-processing facility and the terminal might be seen as an improvement, especially if the terminal roadway is often congested or the close-in parking facility does not provide the type of amenities that today's passengers expect (elevators, SSDs, minimal at-grade crossings, etc.). Walking distances from the APPF could be improved by moving walkways.

Operations Perspective

Passenger-processing facilities that accommodate a variety of functions at locations other than the conventional terminal building could benefit landside operations in a number of ways. First, rather than reconstructing close-in parking facilities or terminal roadways while the terminal remains operational, constructing passenger-processing facilities in areas outside the central terminal area would result in lower construction costs and minimal operational impacts. Using remote parking structures not only for parking but also for curbside operations and check-in or baggage check would be another advantage compared with expanding either the existing terminal roadway system or the terminal itself. Also, combining parking and curbside operations could allow for enforcement to be focused on a few locations compared with enforcing POV parking on the terminal roadway at both the departures curb and the arrivals curb for multiple airlines or even multiple terminals. The opportunity to move an entire mode of transportation (e.g., private or commercial vehicles) into a consolidated location would reduce the number of POVs on the terminal roadway or the number of stops that CVs have to make, thereby reducing the number of CVs required to maintain an appropriate level of service. An APPF or OPPF would also provide an opportunity to accommodate the TSA's 300-ft rule if the airport operator chooses to maintain that distance rather than providing the necessary blast-protection measures. There would also be a security benefit of reducing the number of uninspected check bags in the terminal departures hall.

A major disadvantage of the APPF or OPPF is that, in most cases, it would be difficult to retrofit an existing close-in or remote parking garage to accommodate all of the features that would help make a passenger-processing facility viable. For example, CVs require higher floor-to-ceiling heights than do POVs, and most parking garage entrances are not designed to handle the volume of traffic associated with curbside operations. Reconfiguring an existing garage to accommodate curbside operations may be just as costly as reconfiguring or expanding the terminal roadway. Remote passenger-processing facilities would most likely require an APM connection to the terminal to make the transfer of passengers and baggage more efficient and to provide the level of service that would make the remote facilities comparable with close-in parking facilities. These systems can be very expensive and difficult to integrate into an existing terminal area.

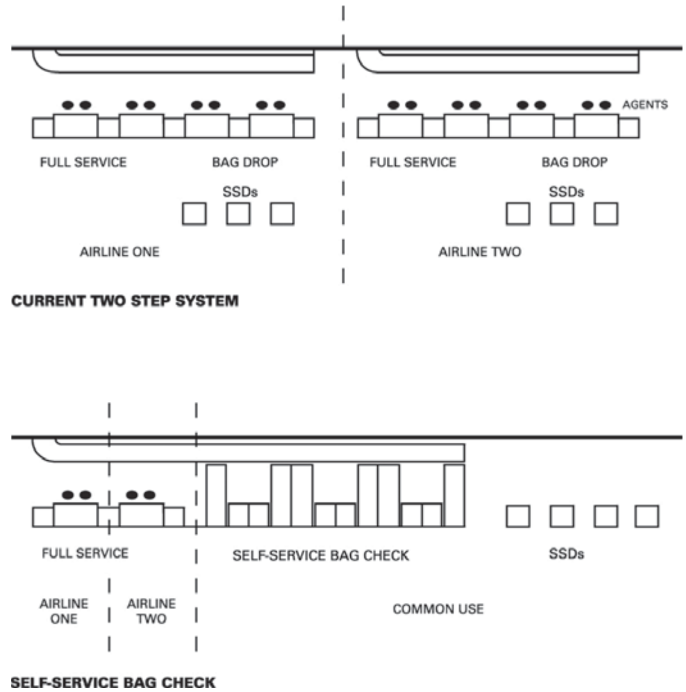

Figure 4-3. Self-service baggage check.

Challenges to Implementation

The implementation of passenger-processing facilities that accommodate a variety of functions at locations other than the conventional terminal building would face many challenges. First, the amount of investment in existing close-in parking facilities would be a major consideration. Another issue would relate to the way passengers would be transported between the passenger-processing facility and the terminal. While busing operations are perceived as not providing as high a level of service as APM systems and as having more significant environmental consequences and operating costs, they may be much easier to integrate with an existing ground transportation system. As with the process-based departures hall, a centralized baggage-screening system would be needed for each terminal (if not for all terminals) to make remote baggage check feasible. In addition, the transportation of checked baggage from either an OPPF or RPPF to the baggage make-up area could present a major challenge, especially from a capital cost standpoint.

Self-Service Baggage Check

The innovation of self-service baggage check is based on the assumption that passengers would be able to tag their own check baggage. In the current two-step self-service check-in system (see Figure 4-3 "Current Two-step System"), passengers obtain boarding passes via an SSD or the Internet (Step 1) and then proceed to a bag drop position (Step 2), where an airline agent prints the appropriate baggage tags and checks the passenger's identification. The passenger's check baggage is tagged and placed on the baggage belt by the airline agent. In contrast, self-service baggage check, in combination with common-use technology, allows for a one-step system where passengers can obtain a boarding pass and tag their own bags in a single location (see Figure 4-3: "Self-service Bag Check"). This method allows airline agents to focus on their full-service customers, for whom they can provide a higher level of service. Roaming customer service agents (provided by the airport operator or a third-party) could patrol the self-service areas and provide support as needed. Passengers who need assistance in the self-service area could be directed to a self-service "help" desk or the full-service counters.

Key Drivers

The key driving force behind self-service baggage check is to further empower passengers to process themselves. Self-service gained tremendous momentum in the banking industry with automated teller machines and has also affected big box retailers and, more recently, fast food businesses. Self-service has become commonplace at airports throughout the world and has reduced passenger-processing times at a lower cost than adding agent positions.

Examples

While self-tagging of check baggage is not currently allowed in the United States, numerous airports in Europe offer self-service baggage check. Vienna International Airport and Munich Airport have implemented both the current two-step system with agent-staffed baggage drop positions in the second step and the one-stop self-service boarding pass and baggage check kiosks. At the one-stop kiosks, passengers swipe an appropriate identification card, obtain a boarding pass, and select the number of bags they wish to check. The kiosk prints the tags for one bag at a time, resolves any weight issues, and then inputs the bag into the baggage-handling system. At both the Vienna and Munich airports, self-service baggage check is provided in or near the train stations that serve the airports, as well as in the departures hall.

Assumptions/Prerequisites

Self-service baggage check relies on self-tagging, which is allowed in certain European countries but not currently permitted by the TSA in the United States. Also, if self-service baggage check is combined with common-use systems, a centralized baggage-screening system would be needed for each terminal so that baggage for any airline could be input at any self-service baggage drop position. These bags would be sorted to the proper airline after they clear the baggage-screening process.

Evaluation

Passenger Perspective

One key advantage of self-service baggage check is that it has the potential to allow check-in at almost any location from which it is feasible to transport baggage to the terminal via either baggage conveyor or manual handling. In addition, self-service baggage check can be accomplished efficiently since additional airline agents would not be needed to tag baggage. Remote placement of SSDs and self-service baggage-drop positions, such as in a parking garage or CRCF, would greatly reduce the need for passengers to transport their check baggage across busy terminal roads; on one or more modes of transportation; or via multiple level changes, particularly in parking garages, for which escalators or elevators may not be available. Remote self-service bag drop would especially benefit the elderly and disabled. Self-service baggage check, implemented in a common-use environment, would also help simplify wayfinding because all self-service functions (boarding pass and baggage check) could be located together rather than apart, as in the current model; in the current model, CUSS kiosks (boarding pass only) are located throughout the departures hall and other parts of the terminal landside, but passengers must access their respective airline facilities to check their baggage.

There are very few disadvantages to self-service baggage check. The biggest disadvantage may be an unintended consequence. An airline's ability to assist passengers during off-schedule operations, which result in large numbers of passengers waiting in a departures hall to change their itineraries, could be affected by the reduced number of full-service agent positions that would be required when self-service baggage check is implemented. However, as many airlines are moving toward a heavier reliance on self-service processes, new strategies for dealing with these types of situations are being developed.

Operations Perspective

The key advantage of self-service baggage check from an operations perspective is increased processing capability without increased staffing requirements. Another advantage is reduced congestion in the departures hall caused by increased passenger-processing capabilities both in the departures hall and at other locations. In addition, the ability to locate SSDs and self-service bag-drop positions at various locations around the airport may present opportunities to generate additional nonairline revenues. For example, the demand for on-airport remote parking may increase because baggage check would be offered as an amenity that may not be offered at off-airport parking locations.

One disadvantage to self-service baggage check is the potential impact on the baggage-handling system, in particular, on the ticket counter take-away belt. As passenger-processing rates—and, therefore, peak baggage demand—increase with self-service baggage check, the take-away belt, which has a limited capacity due to the speed at which it can operate safely, would be more fully utilized. Allowing passengers to place their baggage directly on the take-away belt may increase downstream conveyor jams as different types of bags (e.g., wheeled, soft-sided) must be placed on the take-away belt in different ways. Other issues that should be examined in more detail include controls for preventing false claims of lost baggage (i.e., passengers claiming that they input a bag when they did not) and the impact of self-tagging on baggage-handling system misread rates.

Challenges to Implementation

There are a few challenges to implementing self-service baggage check. The one major challenge is that current security regulations must be changed to allow passenger self-tagging of baggage. Retrofitting existing ticket counters and installing self-service baggage check-capable devices would require modifications, but would not present a major challenge. Industry acceptance of self-tagging should not present a major challenge as discussions with airport and airline representatives regarding self-service baggage check were generally very positive; both entities see the advantages of this innovation and believe that the disadvantages could be overcome. The concept has also been embraced by IATA through its Simplifying the Business initiative.

Bag-Check Plaza

The bag-check plaza would allow passengers to use SSDs to check in for flights, obtain boarding passes, and check bags while remaining with their vehicles. Upon completion of this process, passengers would proceed to park their vehicles or their well-wishers would drop them off at the curbside. While bag-check plazas could be located at close-in or remote parking facilities, Figure 4-4 illustrates the general location of a drive-through self-service bag-check plaza that would serve a close-in parking structure and terminal building curbside. Baggage would be transferred to the terminal building or, alternatively, to a remote baggage-screening facility. A bag-check plaza serving close-in parking facilities could use motorized belts to transport baggage directly to the processing area, while remote facilities would likely require the bags to be trucked to the baggage-processing area. Figures 4-5 and 4-6 illustrate two alternative layouts for the bag-check plaza.

Key Drivers

The construction of a bag-check plaza would be driven by the need to decrease congestion on the curbside roadway and departures hall without increasing their physical size. Allowing passengers to check their bags at a location other than the curbside would reduce the curbside roadway congestion associated with those vehicles dropping off passengers and baggage before parking. These facilities would also provide a customer service benefit resulting from the ability to check baggage prior to walking to the terminal building from parking. Passengers using the bag-check plaza could then bypass the ticketing and baggage check area of the terminal building and proceed directly to the SSCP, thereby reducing congestion in the ticketing area and potentially deferring future capital expenses associated with expanding the departures hall.

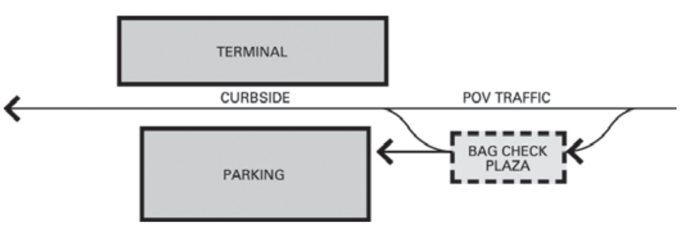

Figure 4-4. Bag-check plaza.

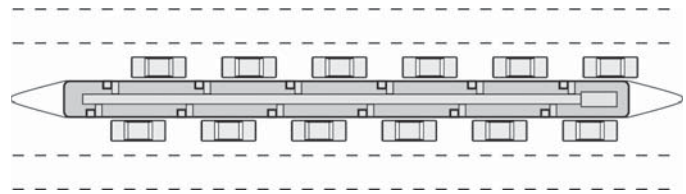

Figure 4-5. Bag-check plaza—linear layout.

Examples

A facility similar to the bag-check plazas currently in place at some airports is the remote baggage check-in facility. Multiple airports in the United States allow third-party vendors to accept check bags and provide boarding passes to passengers for a fee. At San Francisco International Airport, for example, passengers using the long-term parking facility can check bags and obtain boarding passes for daily domestic departures on 11 different airlines serving the airport. The service is operated by a third-party vendor that charges a nominal fee based on the number of bags checked. Passengers are required to check their bags at least 75 min prior to their flight if using this parking facility.

At Honolulu International Airport, Hawaiian Airlines and Aloha Airlines (prior to its cessation of service in April 2008) offer(ed) drive-through bag check in the close-in parking

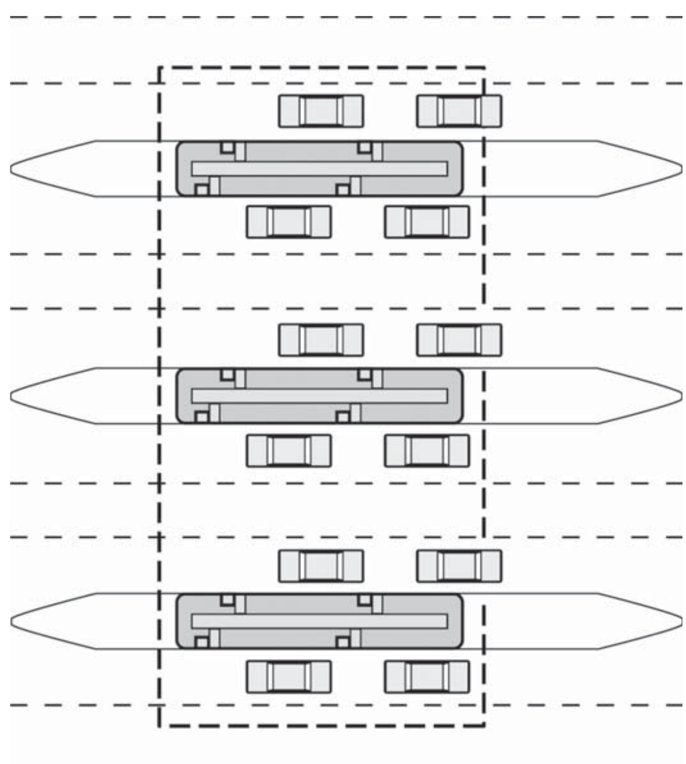

Figure 4-6. Bag-check plaza—parallel layout.

Figure 4-7. Hawaiian Airlines drive-through check-in at Honolulu International Airport. Source: TransSolutions, LLC.

structure, as shown in Figure 4-7 and Figure 4-8, respectively. Passengers drive their vehicles to a bag-check-in area located adjacent to the terminal or inside the parking structure. Vehicles are parked in drive-through-style parking spaces before passengers exit their vehicles to check their baggage and retrieve their boarding passes. When this transaction is completed, passengers return to their vehicles and drive to an available space in the garage or drop their parties off at the departures curb. These passengers then proceed directly to the SSCP with their boarding passes in hand.

Assumptions/Prerequisites

It is anticipated that bag-check plazas would be designed primarily for POVs (including returning rental car customers) that have two to four occupants wishing to check bags and obtain boarding passes. The suitability of this type of facility at an airport will depend upon many factors specific to the unique airport environment, including physical constraints. However, in general, those airports accommodating a high percentage of POV activity would likely be better suited for a bag-check plaza. To reduce staffing requirements and transaction times, it was assumed that the facility would be self-service and that passengers would be able to tag their own bags prior to putting them onto the baggage conveyor belt. To capture as many passengers wishing to check baggage as possible, the facility would best be located in advance of high-capacity parking facilities offering a long-term product that caters to leisure and business travelers on long trips who are likely to have check baggage. It is unlikely that a bag-check plaza serving only a short-term (i.e., more expensive) parking garage would produce sufficient demand to make the facility viable since it tends to attract business travelers on short-trips who likely aren't checking bags.

Figure 4-8. Aloha Airlines drive-through check-in at Honolulu International Airport. Source: TransSolutions, LLC.

Evaluation

Passenger Perspective

The primary advantage of the bag-check plaza is that it relieves passengers of the need to carry their baggage from a close-in or remote parking facility to the terminal building. Regardless of how close to the terminal they park, passengers are still burdened by having to carry their baggage into the building and to the check-in counter. In some cases, this process may require getting onto and off of a shuttle bus, which is particularly difficult for elderly and disabled passengers. Those passengers who would typically drop off their families and baggage at the curbside before parking could save time by checking their baggage at the bag-check plaza and then parking. Once parked, passengers can avoid the inconvenience of congestion and delays in the departures hall and proceed directly to the SSCP.

A disadvantage could be that passengers have become accustomed to receiving assistance from an airline representative if they have any difficulty checking in at a kiosk in the departures hall. Because the bag-check plaza would provide CUSS kiosks, passengers would not be able to speak directly with an airline representative. However, a roaming customer service agent would be available to provide assistance. Novice travelers who do not fully understand the check-in process may become confused and require more time, which would increase wait times for other passengers.

In addition, the airline cut-off time for receiving bags at a remote bag-check plaza may require earlier-than-desired check-in times for departing passengers, depending on the method used to transfer the bags to the terminal. This earlier required check-in time may reduce the use of the bag-check plaza, which would, therefore, reduce its potential advantages.

Operations Perspective

Providing passengers the opportunity to check baggage before parking has the potential to reduce curbside roadway congestion associated with passenger drop-off and curbside check-in. Patrons who would typically drop off other members of their parties and their baggage at the curbside before parking could check their baggage at the bag-check plaza and then proceed directly to parking, thereby reducing the number of vehicles using the curbside roadway. This process would enable the airport operator to decrease curbside roadway congestion and enforcement without adding physical capacity. The bag-check plaza would also supplement the capacity of check-in facilities in the terminal by allowing passengers to bypass the ticket counter and proceed directly to the SSCP.

The bag-check plaza could also increase the seating capacity and improve the loading efficiency of shuttle bus services from remote lots because passengers have already checked their baggage. These advantages may then lead to a reduction in the number of shuttle buses in operation, which would, therefore, reduce operational costs and provide environmental benefits.

A bag-check plaza serving close-in parking lots would need to be constructed in what is likely already a congested area. Regardless of whether the facility is close-in or remote, the required footprint may reduce the number of available parking spaces if it is constructed on an existing parking lot, which could have a negative impact on parking revenues.

Depending on the location of the bag-check plaza, baggage would have to be transported to a baggage-screening area either by truck or an automated conveyance system. The cost to convey bags from a remote location to the terminal area would likely be substantial.

Simulation Analysis

To estimate the required size of a bag-check plaza, a computer simulation analysis was conducted at a medium-hub airport with a high percentage (77%) of POVs. The four-airline terminal at the selected airport accommodates approximately 1,200 peak hour enplaned passengers. Assuming that 60% of the passengers with check baggage use the bag-check plaza, a total of 12 self-service positions would be required to accommodate demand. If 40% of the passengers with check baggage use the bag-check plaza, eight self-service positions would be required. In addition, an average of four or five spaces per check-in position should be provided for vehicle staging (i.e., parked or in queue). Inside the terminal departures hall, the maximum passenger queues would be reduced by 50% or more. Detailed results of this analysis are included in the appendix.

Challenges to Implementation

The primary challenges to implementing the bag-check plaza would be the cost and operational difficulties of transporting baggage from the plaza to the baggage-processing area. In addition, passengers must be able to tag their own check baggage. Other challenges, such as the availability of land to construct the facility and the potential impact on parking space supply, would also need to be considered. The success of such facilities would likely relate to the ability to generate enough volume to justify the capital and operational costs.

Supplemental Curbsides

The curbside roadway accommodating POV and CV traffic has historically been adjacent to the terminal building, and the manner in which POVs and CVs are separated varies from airport to airport. Curbsides are typically designed to minimize walking distances by providing passengers proximity to the terminal building entrance associated with their airline. However, increased vehicle demand and the passengers' desire to be dropped off directly in front of the door creates a high level of congestion along certain areas of the curbside while leaving other areas underutilized. Moving a portion, or in the case of a new terminal, all of the curbside functions into an adjacent parking structure or surface lot would allow for the dispersion of vehicle demand along the curbside frontage and would significantly increase curbside capacity.

Supplemental curbsides located near the terminal building could be combined with pedestrian bridges to reduce or eliminate at-grade lane crossings and to improve pedestrian safety and roadway operations. One arrangement might consist of a supplemental curbside in the parking structure and another "traditional" curbside serving an adjacent terminal (see Figure 4-9: "Terminal and Garage"). This arrangement would be more appropriate for an existing terminal layout where certain transportation modes are moved from the existing curbside to the parking structure. For example, departing passengers could be dropped off in the parking structure and cross an elevated pedestrian bridge directly into the ticketing hall without having to cross any lanes of traffic. Another alternative might relocate all curbside functions inside a parking structure (see Figure 4-9: "Garage Only"). Because it is unlikely that existing roadway infrastructure adjacent to the terminal building would be abandoned, this layout would best be designed as part of the construction of a new terminal. Transportation modes could be assigned to separate levels of the parking structure and could provide direct access to and from the terminal building. A courtyard or other "outdoor space" could then be provided between the parking structure and the terminal building, similar to the

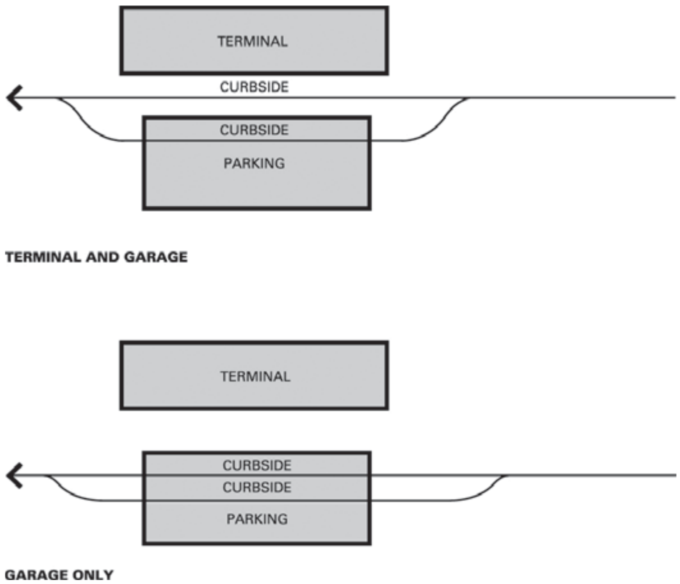

Figure 4-9. Supplemental curbsides.

arrangement developed for the recently opened Terminal 5 at London's Heathrow Airport.

Key Drivers

The implementation of supplemental curbsides would be driven by the need for additional curbside frontage capacity and curbside roadway throughput capacity, as well a desire to improve pedestrian safety by reducing the number of traffic lanes that passengers must cross to access the terminal (as opposed to providing additional curbside islands accessed via crosswalks).

Examples

Opened in March 2008, Terminal 5 at London's Heathrow Airport is the most recent example of a new terminal designed with both POV and CV curbsides located within an adjacent parking structure (see Figure 2-1). This "remote curb" terminal accommodates departures and arrivals (POV and CV) on the upper level or roof of the parking structure and has a bus and coach station on the lower level. Departing passengers cross an elevated pedestrian bridge from the upper level directly into the departures hall while arriving passengers cross the landscaped plaza from baggage claim to the elevator banks on the lower level that access the parking levels and the arrivals curb. This separation of traffic minimizes the number of traffic lanes that pedestrians must cross.

At San Diego International Airport, Terminals 1 and 2 each have a supplemental curbside located on a portion of the surface parking lot adjacent to the terminal. The curbside accommodates commercial vehicles such as hotel/motel shuttles, rental car shuttles, and taxicabs. An elevated bridge over the terminal curbside roadway provides a grade-separated pedestrian path between the terminal building and the supplemental curbside.

Terminal 2 at Munich Airport has supplemental curbsides (see Figure 2-2) in the form of forecourts on each side of the terminal building, with POVs on one side of the terminal and CVs on the other. Each forecourt has two levels: the upper level for departures and the lower level for arrivals.

Assumptions/Prerequisites

A supplemental curbside could be implemented either as part of an existing parking structure modified to provide a traditional curbside or as part of a new terminal facility. In either scenario, to the extent possible, it is desirable to plan a curbside within an adjacent parking structure to provide vertical separation to reduce vehicle and pedestrian conflicts and to reduce walking distances and the number of traffic lanes that passengers must cross to enter the terminal. Similar to the San Diego International Airport arrangement, those airports without an adjacent parking structure could provide a supplemental curbside in an adjacent surface lot.

Evaluation

Passenger Perspective

A conventional curbside consisting of multiple islands requires passengers to cross multiple lanes of traffic. Providing a supplemental curbside in a parking structure allows passengers to cross from the structure to the terminal via a grade-separated walkway. Reducing the number of traffic lanes that must be crossed to access the terminal provides passengers with a sense of improved safety and convenience.

The primary disadvantage of the supplemental curbside is that it could result in longer passenger walking distances. Passengers accustomed to being dropped off directly adjacent to the terminal would be required to walk from the parking structure to the terminal. The walking distances could, however, be mitigated by providing moving walkways.

Operations Perspective

Increasing capacity for curbside operations reduces traffic congestion, thereby improving traffic operations and safety. A supplemental curbside would also allow airport operators to separate POV and CV traffic. At airports where both POVs and CVs drop off passengers on the departures level, the ability to move one or the other to the supplemental curbside would be provided, thereby increasing the curbside capacity for both mode types.

Similar to the bag-check plaza, the area required to construct the supplemental curbside in an existing parking structure may require eliminating some revenue-generating parking spaces. This reduced capacity would then constrain existing close-in parking, which could be difficult to replace.

Passengers accustomed to one curbside location for drop off and another curbside location for pickup may be confused by the introduction of an additional curbside. The provision of multiple curbside locations may result in wayfinding complexity for passengers in vehicles and on foot.

Challenges to Implementation

The cost to reconfigure an existing parking structure to accommodate a supplemental curbside would be the primary challenge to implementation. Physical constraints imposed by existing facilities (e.g., column spacing, inadequate floor-to-ceiling height) may limit the ability to retrofit an existing parking structure to accommodate a supplemental curbside. The challenges to implementation with a new parking structure would be how to realign the existing terminal roadway system to accommodate the supplemental curbside located in the structure.

Passenger Assistance Parking Area

After September 11, 2001, vehicles are no longer allowed to dwell on the curbside unless they are involved in the active loading or unloading of passengers. Those individuals wishing to accompany a departing passenger or to meet an arriving passenger at the majority of large- and medium-hub U.S. airports are required either to pay a fee to park or to drop the passengers off or pick them up directly at the terminal curbside. As a result of this increased level of curbside enforcement, many meeters and greeters desiring to pick up passengers at the curbside have elected to recirculate along the airport roadway system rather than enter the airport parking facilities. This recirculating activity has resulted in increased roadway and curbside congestion. Some airport operators have implemented remote cell phone lots where meeters and greeters who arrive at the airport in advance of an arriving flight can wait in their vehicles for arriving passengers.

The passenger assistance parking area (see Figure 4-10) would provide a number of dedicated parking spaces in a close-in parking facility or at the terminal curbside, within reasonable walking distance of the terminal, to allow visitors to accompany passenger(s) to or from the terminal. The parking area could be free of charge, and vehicle parking time would be limited to approximately 10 to 15 min. It is anticipated that these parking areas would generally serve meeters and greeters and well-wishers.

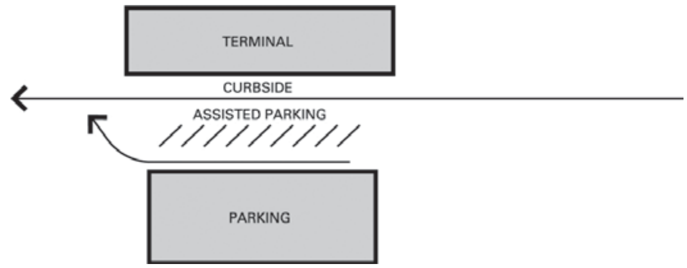

Figure 4-10. Passenger assistance parking area.

Key Drivers

The key drivers to providing a passenger assistance parking area would be the desire to provide a high level of customer service for meeters and greeters and well-wishers accompanying an airline passenger to or from the terminal and to encourage these meeters and greeters and well-wishers to park their vehicles rather than circling the on-airport roadway system. Such passenger assistance parking areas would be especially beneficial for the elderly, the disabled, and families with small children.

Examples

A variation of a passenger assistance parking area is provided on the arrivals level of Nashville International Airport. Vehicles pull into spaces where they are allotted 10 min to greet and assist their passengers with their baggage. A digital clock positioned above each space counts down the 10-min grace period each vehicle is allowed in the parking space. Airport staff monitor the spaces on a continual basis and will issue tickets and, if necessary, tow any vehicle that exceeds its time limit. Similar very-short-term parking spaces are provided at Munich Airport's Terminal 2.

Assumptions/Prerequisites

Provision of a passenger assistance parking area would require that a fixed number of spaces be available proximate to the terminal. The spaces should be located in an area where the number of lanes a passenger must cross is minimized to reduce potential vehicle and pedestrian conflict points and to promote a higher level of safety. The spaces could be free of charge, and the vehicle would be allowed to stay in the space for 10 to 15 min. To ensure that vehicles do not exceed the allotted grace period, strict enforcement would be required.

Evaluation

Passenger Perspective

The primary advantage of the passenger assistance parking area is that it enables well-wishers and meeters and greeters to personally assist their passenger to or from the terminal building rather than quickly dropping them off or picking them up at the curbside. The passenger assistance parking area provides close and convenient parking spaces as opposed to spaces that may require longer walking distances.

Because parking in the passenger assistance parking area would be limited to 10 to 15 min, aircraft delays may result in visitors being required to leave these limited-time spaces and move to public parking or, alternatively, to a remotely located cell phone lot, which could lead to more congestion on terminal roadways. Meeters and greeters would also be required to time their arrival so they would not have to dwell for long periods of time.

Operations Perspective

Providing a passenger assistance parking area would result in fewer recirculating vehicles on airport roadways. Similar to a cell phone lot, this innovation provides a close-in parking area for patrons wishing to meet their passengers without needing to recirculate. However, the provision of a passenger assistance parking area in an existing parking facility has the potential to eliminate some parking spaces and, subsequently, the revenue generated by those spaces. The provision of this parking product would also likely require additional staff for enforcement.

Challenges to Implementation

Airport operators may not have the ability to eliminate existing close-in parking capacity or related revenue to accommodate a passenger assistance parking area. The passenger assistance parking area would also have to be located outside of the area where a revenue control system is in effect; therefore, an entry/exit location separate from parking may be required.

Low-Profile Passenger Baggage Devices

Passenger baggage devices consist of ticket counter bag wells, used for depositing check baggage with the airline, and baggage-claim devices, used for claiming checked baggage at the point of arrival. The common passenger baggage devices (see Figure 4-11: "Typical Arrangement" and Figure 4-12: "Typical Carousel Claim") require passengers to either lift their check baggage approximately 10 to 12 in. off the floor to place them in the bag well for the ticket counter agent to weigh each bag and apply a bag tag or to lift their bags over the typical 8-in. threshold of a slope-plate baggage-claim carousel. In addition, bags are often double-stacked on slope-plate carousel devices, potentially requiring passengers to reach over another bag to lift their bag off the device. Both activities are difficult for the elderly and, in many cases, even for the average passenger. Traditional passenger baggage devices are also a hazard for airline agents who may have to move a checked bag approximately 30 in. to 36 in. from the bag well to the take-away belt.

Low-profile passenger baggage devices address these issues and help prevent both passenger and agent injuries. Low-profile ticket counter bag wells (for a common example, see Figure 4-11: "Low Profile") have been used at airports around the world for a number of years, but have not been widely implemented in the United States due to the higher cost compared with traditional devices. Low-profile ticket counter baggage devices require an additional feeder belt that

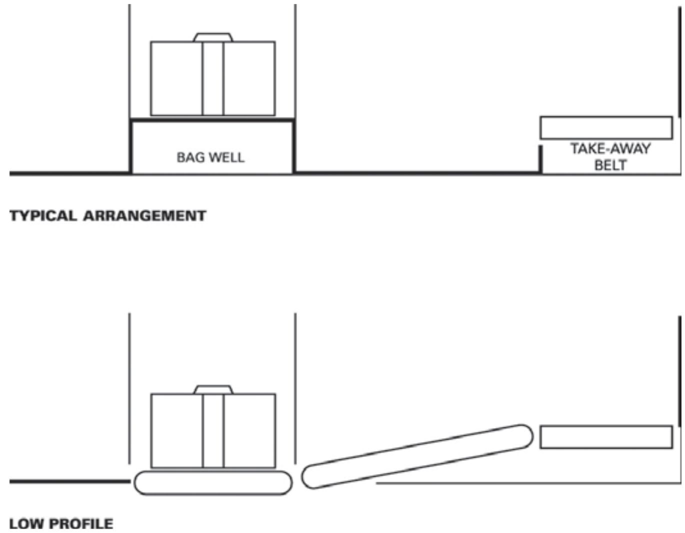

Figure 4-11. Low-profile ticket counter bag wells.

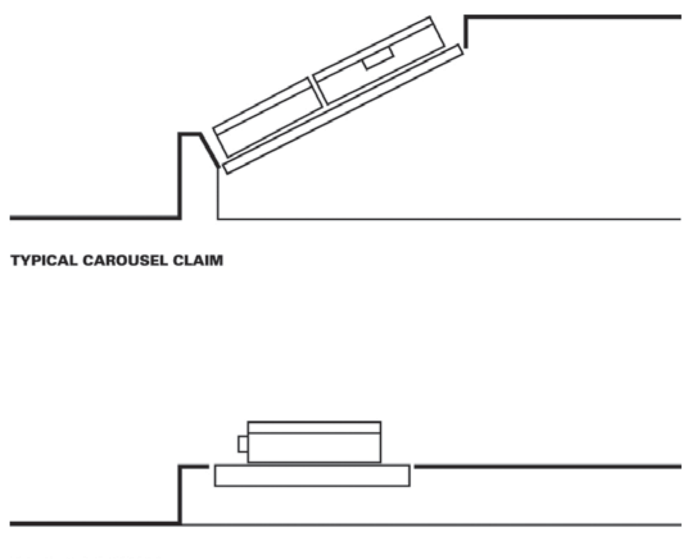

Figure 4-12. Low-profile bag claim devices.

transports the checked baggage from the bag well to the take-away belt. These devices require additional controls and synchronization with the take-away belt to prevent jams on the take-away belt. While low-profile ticket counter bag well devices can be recessed into the structure to be nearly flush with the floor, typical applications result in a 4-in. to 6-in. floor-to-bag-well separation. Figure 4-13 provides an example of a low-profile ticket counter bag well at Vienna International Airport.

Low-profile baggage claim devices—particularly flat-plate claim devices (see Figure 4-12: "Flat Plate Claim")—are more common than their ticket counter equivalent, but are still not as widely implemented as slope-plate carousels. One reason for the lack of implementation of low-profile devices is the additional capacity created by double-stacking bags on slope-plate carousels. Another reason is that arriving baggage is typically loaded directly onto flat-plate devices, which limits passengers from circulating around all sides of the claim device because a portion is located behind a wall that separates secure and nonsecure areas. However, remotely fed flat-plate devices are available and in use at some European airports. Slope-plate carousels allow for the baggage drop-off point to be located closer to the gate, which helps improve aircraft-to-claim times. Low-profile slope-plate carousel devices and remotely fed flat-plate devices address the issues associated with lifting bags off of bag-claim devices.

Key Drivers

The aging population's propensity for airline travel is the major driver for implementation of low-profile passenger baggage devices. As more elderly persons choose airline travel for leisure trips, the impact of traditional passenger baggage devices will become increasingly more noticeable. When these passengers take long trips with a number of check bags, the task of placing those bags on ticket counter bag wells and removing them from bag-claim devices, particularly slope-plate devices, becomes more arduous and likely to cause injury or discomfort.

Figure 4-13. Low-profile ticket counter bag well at Vienna International Airport. Source: Corgan Associates, Inc.

Examples

Several recently constructed terminals that accommodate both domestic and international passengers such as Dallas/Fort Worth International Airport's Terminal D, John F. Kennedy International Airport's Terminal 8, and Miami International Airport's North Terminal (currently under construction) use (or will use) low-profile ticket counter bag well conveyors that require passengers to lift their bags 8 in. or less and do not require the agent to lift bags at all. However, slope-plate baggage-claim devices are used at many of these airports. Flat plate baggage-claim devices are more commonly found at small-hub airports where the departures and arrivals halls are on the same level as the aircraft apron, reducing the need for more costly remote-feed slope-plate devices.

Assumptions/Prerequisites

The only assumption regarding low-profile passenger baggage devices is that the benefits of providing a higher level of passenger service, particularly for the elderly and disabled, will outweigh the airline and airport operator costs to provide the low-profile devices. While it is certainly easier to include low-profile ticket counter bag well conveyors in new construction or major renovations, most existing ticket counter conveyor systems can be retrofitted to accommodate the low-profile devices.

Evaluation

Passenger Perspective

The biggest advantage of low-profile devices for passengers is the increased ease of placing check baggage on the ticket counter bag well conveyors and removing checked baggage from either low-profile slope plate or flat plate baggage-claim devices. Low-profile passenger baggage devices present virtually no disadvantages to passengers.

Operations Perspective

Low-profile ticket counter bag wells help prevent airline agent injuries associated with lifting heavy check bags from the bag well to the take-away belt. Low-profile ticket counter bag wells, particularly those with feeder belts, are more expensive to install and maintain due to the additional conveyor components and the controls required to coordinate the movement of the check bags from the feeder belt onto the take-away belt. Low-profile baggage claim devices may actually reduce baggage-claim capacity; however, they are typically less costly to install. There are also potential security concerns with direct-feed flat-plate devices in that circulating bags travel unimpeded from the nonsecure bag claim area to the secure area if they are not immediately claimed by passengers.

Challenges to Implementation

The main challenge to implementing low-profile ticket counter bag well devices is the additional cost of an installation that primarily provides enhancements to customer service, rather than reducing operating costs. These types of customer-service enhancements often do not pass traditional benefit-cost analysis and must be supported by a larger desire to accommodate not only mainstream passengers, but also the increasing number of aging and disabled passengers, as well as leisure travelers with one or more check bags. The challenge to implementing low-profile baggage-claim devices is that they provide lower capacities than do traditional slope-plate devices.

High-Capacity Flow-Through Elevators

Most U.S. airport terminals use escalators as the primary mode of vertical transition for passengers. Elevators, which are required by the Americans with Disabilities Act, are typically located in proximity to the escalators, but are not usually in the primary path of travel or in the passenger's line of sight (see Figure 4-14: "Typical Arrangement"). As a result, passengers may elect to use the escalators even if they do not feel comfortable riding on them. Escalators are even more problematic when passengers have not had the opportunity to deposit their check baggage with the airline.

High-capacity flow-through elevators are not commonly found in U.S. airport terminals, although they are used in some high-rise buildings and transit centers to transport passengers between popular destinations. These elevators are designed to operate on a fixed schedule and act more like a vertical people mover than a traditional elevator. High-capacity flow-through elevators, unlike traditional elevators, are intended to be in the passenger path of travel (see Figure 4-14: "Flow Through Arrangement") and can open on both sides of the elevator cab. These types of elevators are frequently used in subterranean transit stations where there is a relatively constant flow of passengers and escalators are not available. While escalators would still be provided to accommodate the many passengers who are comfortable using them, high-capacity flow-through elevators would accommodate the needs not only of the disabled, but also of the elderly and those traveling with small children. These devices could be provided either in the terminal or in landside facilities, such as multistory parking structures.

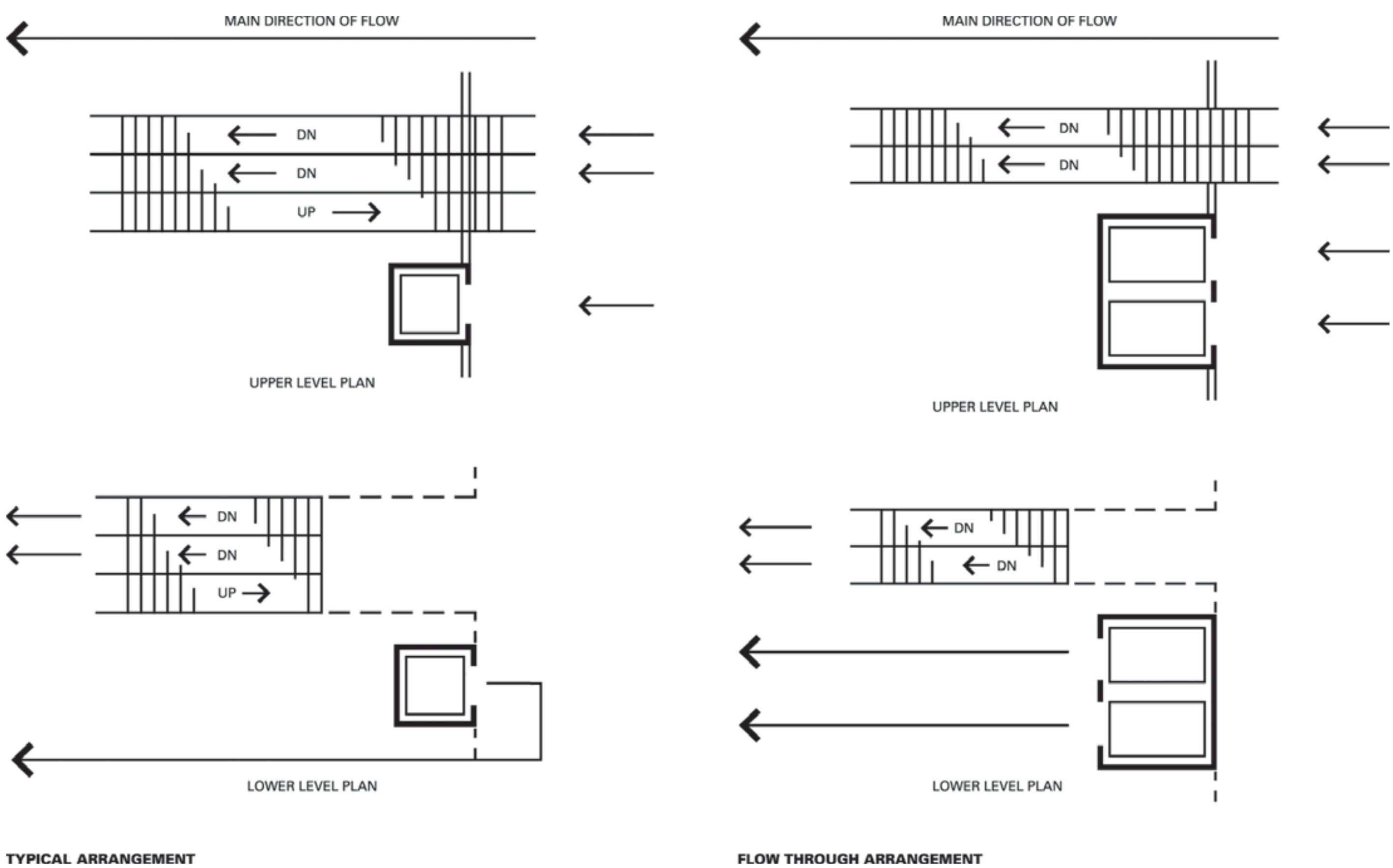

Figure 4-14. High-capacity flow-through elevators.

Key Drivers

The primary driving force supporting the need for high-capacity flow-through elevators is the aging population. As identified in Chapter 2, vertical transitions via escalators or stairs, particularly with check baggage, is one of the biggest issues for elderly and disabled passengers. Escalators are also challenging for families traveling with small children. Also, baggage carts are typically prohibited from escalators, so passengers must deviate from the primary path of travel to continue using their baggage carts.

Examples

Heathrow Airport's recently opened Terminal 5 uses banks of five high-capacity flow-through elevators to transport passengers primarily between the transit station located below the pedestrian plaza and the departures level (see Figure 2-1). These elevators (see Figure 4-15) are located on the terminal side of the parking structure, run on preprogrammed schedules, and have a 50-person capacity. Additional banks of high-capacity flow-through elevators provide passengers access between the different levels of the parking structure and the departures and arrivals levels of the terminal. Passengers traveling between the parking structure and the terminal with check baggage have a much easier trip, especially since the arrivals and departures curbs are located in the parking structure.

Assumptions/Prerequisites

High-capacity flow-through elevators require a relatively constant demand to be effective. Multilevel terminals with baggage claim and ground transportation on the lower level and the departures hall, SSCP, and gates on the upper level are obviously well suited for high-capacity flow-through elevators. Multilevel terminals provide the opportunity to channel the steady flow of arriving passengers to the baggage-claim area using high-capacity flow-through elevators in addition to escalators. Terminals with additional levels for parking or transit stations would also be excellent candidates.

Figure 4-15. Heathrow Airport Terminal 5—high-capacity flow-through elevators. Source: Corgan Associates, Inc.

Evaluation

Passenger Perspective

The biggest advantage to passengers is the ease of vertical transition, particularly for passengers with check baggage. The fact that these types of elevators are better suited to be in the primary path of travel also benefits other passengers, such as the elderly and disabled, who would prefer not to use escalators or stairs. It is also more convenient for passengers, especially those with baggage carts or in wheel chairs, to enter on one side of an elevator and exit through the other side, eliminating the first-in, last-out loading and unloading of standard elevators.

The major disadvantage to high-capacity flow-through elevators is that, during peak periods, there may be some queuing in front of the elevators whereas escalators rarely have queues. However, if these elevators are used in conjunction with escalators as illustrated in Figure 4-14, some passengers who intended to use the elevators may decide to use the escalators, keeping the queue to a minimum.

Operations Perspective

High-capacity flow-through elevators, much like traditional elevators, help reduce the number of injuries to passengers as compared with escalators. They could also satisfy the Americans with Disabilities Act requirements for elevators, so duplicate elevators would not be required. Another advantage would be that the elevator schedules could be set to reduce the number of trips during nonpeak periods, reducing wear and energy consumption.

One disadvantage to high-capacity flow-through elevators is the need for two or more at each location to maintain acceptable frequencies and to achieve the desired level of service. Most traditional elevators are not intended to be the primary mode of vertical transportation, so only one is installed in most locations.

Challenges to Implementation

The biggest challenge to widespread implementation of high-capacity flow-through elevators is the familiarity with and preference for escalators by U.S. passengers. Another big challenge is that the retrofitting of existing buildings that would be required to accommodate large elevators may not pass the benefit-cost analysis as the existing escalators most likely satisfy the need for assisted vertical transportation. Retrofitting parking structures with elevators is equally challenging.

Consolidated Meeters-and-Greeters Area

Meeters and greeters were affected greatly by the changes in security regulations following the September 11, 2001, terrorist attacks. Before these changes, meeters and greeters could pass through security and meet passengers at the gate and then accompany them to claim their bags or proceed directly to their vehicles. Today, meeters and greeters typically wait in their vehicles for a telephone call (via cell phone) from the arriving passengers they plan to pick up. Sometimes, cell phone lots are provided for waiting meeters and greeters, reducing unnecessary recirculation, emissions, and roadway congestion. However, meeters and greeters present a valuable revenue stream that is minimized by the use of cell phone lots.

A common factor complicating the meters-and-greeters process is that multiple exits are typically provided from the secure area to the arrivals hall (see Figure 4-16: "Multiple Exits"). While multiple exits help distribute passenger traffic, they make it difficult for meeters and greeters to know where to meet passengers as they enter the arrivals hall. A consolidated meters-and-greeters area (see Figure 4-16: "Consolidated Meeters and Greeters") not only would simplify the act of meeting and greeting arriving passengers by creating a single exit from the secure area to the arrivals hall, but also would capture this potential revenue stream. A single exit from the secure area into an arrivals hall that serves one or more airlines, similar to international arrivals, would allow meeters and greeters to arrive at the terminal without contacting the arriving party to ascertain which bag-claim device their flight has been assigned. As there would only be one exit, the meeters and greeters could go directly to the single exit and wait for their parties to arrive. This dwell time provides a natural opportunity to provide concessions and other amenities, such as baggage carts or restrooms. The meeters and greeters could also use revenue-producing short-term parking rather than waiting in a no-fee cell phone lot.

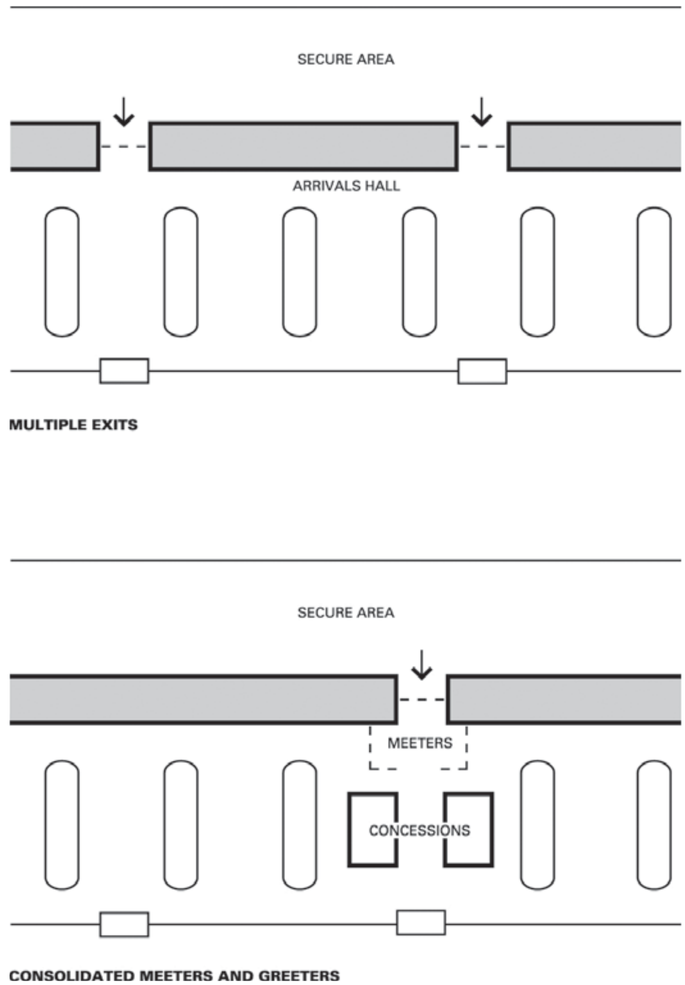

Figure 4-16. Consolidated meeters-and-greeters area.

Key Drivers

Increased nonairline revenue is a significant advantage of providing consolidated meters-and-greeters areas. At many airports, meeters and greeters represent a revenue source that is not being captured because there is no central location where they can meet their parties. The increasing numbers of aging passengers are another driver of consolidated meters-and-greeters areas. Claiming checked baggage is often a difficult task for the elderly and the disabled, who have a hard time removing baggage from slope-plate claim devices. These passengers would greatly benefit from a single exit from the secure area to the arrivals hall by being able to meet the people picking them up before they claim their checked baggage rather than meeting them at the curb. Another driver is the number of exits that have to be monitored by airline or airport personnel. When exits are located remote from the SSCP, either the airlines using the arrivals hall or the airport operator must provide security guards to monitor the exit, even if automated revolving doors are installed. Consolidating the number of exits from the secure area to each arrivals hall would reduce the cost of providing that security.

Examples

Most terminal buildings have either multiple domestic arrivals halls or multiple portals in a single domestic arrivals hall because of its size. In contrast, international arrivals facilities typically have a single exit into the nonsecure area. These locations are often characterized by congregating meeters and greeters and may provide concessions and other amenities.

Assumptions/Prerequisites

One major assumption pertaining to a consolidated meters-and-greeters area is that it would not create inequitable walking distances. Another assumption is that there would be a sufficient flow of arriving passengers claiming checked baggage to justify some level of concessions, whether they be sundries, a newsstand, a coffee bar, or vending machines. One prerequisite would be that ample short-term parking must be located adjacent to each arrivals hall to accommodate meeters' and greeters' vehicles.

Evaluation

Passenger Perspective

Simplified wayfinding is one advantage of consolidating the meters-and-greeters area. This advantage affects both passengers and meeters and greeters. Passengers could be directed to a single exit to access the arrivals hall, and that exit would serve as a single point of entry for meeters and greeters to wait for their parties. Another advantage is that aging passengers would be able to receive assistance from the parties picking them up rather than the meeters and greeters waiting in a cell phone lot until the passenger is either in the arrivals hall or at the arrivals curb. The availability of concessions or amenities, such as restrooms or baggage carts, made possible by consolidating the meters-and-greeters area would be another advantage for passengers.

One potential disadvantage is that reducing the number of exits into the arrivals hall may increase the walking distances from the gates to the bag-claim devices. However, as passengers often arrive at the bag-claim devices well before their baggage, the availability of concessions or amenities would most likely outweigh the increased walking distances.

Operations Perspective

The potential to increase nonairline revenue by capturing meters-and-greeters traffic is the most significant operational advantage. Consolidated meters-and-greeters areas would also provide a great opportunity to reduce security staffing requirements by reducing the number of exits from the secure area to the arrivals hall. Such areas might also help reduce the need for constant enforcement of curbside regulations by encouraging meeters and greeters to use short-term parking to meet their parties at a single location rather than recirculating on the terminal roadway or waiting at the arrivals curb for the passengers they are picking up to contact them or to emerge.

An operational disadvantage of a consolidated meters-and-greeters area would be the potential concentration of demand for short-term parking in proximity to the consolidated meters-and-greeters area. Another disadvantage might be the added congestion caused by meeters and greeters waiting for their parties inside the arrivals hall.

Challenges to Implementation

One major challenge to providing a consolidated meters-and-greeters area would be the existence of a sufficient traffic flow to justify the concessions or amenities needed to make the function more attractive than using a cell phone lot. However, the use of a single exit not only for passengers claiming checked baggage, but also for passengers exiting the secure area and heading directly to the arrivals curb or parking garage because they have no baggage to claim could mitigate this challenge. Those passengers without baggage to claim may be interested in either the concessions or amenities, particularly restrooms, before they exit the airport.

Arrivals Lounges

Typically, arriving passengers using ground transportation claim their checked baggage or go straight to the arrivals curb and wait for their desired mode of transportation (see Figure 4-17: "Typical Arrivals Roadway"). Often, there is little shelter from the elements and no indication of when the next awaited vehicle is scheduled to arrive. Also, the commercial curb is generally an island curb requiring passengers to cross POV traffic on the inner curb roadway.

Arrivals lounges (see Figure 4-17: "Arrivals Lounge Concept") would provide the same level of service to arriving passengers as that provided to departing passengers by offering a comfortable waiting area and the necessary information to ease traveler anxiety. These arrivals lounges may include a check-in kiosk to alert drivers that customers are waiting for their shuttles, as well as information displays identifying when the next vehicle is expected to arrive. An enclosed waiting area would be provided that would be much more comfortable than the outdoor areas common at many airports. It is anticipated that several lounge areas would serve different CV types such as hotel shuttles, rental car shuttles, interterminal transit, and so forth.

Key Drivers

Passenger level of service is the main driver of arrivals lounges. Arriving passengers are typically not provided the same level of service as departing passengers. Arrivals halls typically are not the grand spaces that departures halls are, and the curbside environment is nowhere near as nice as

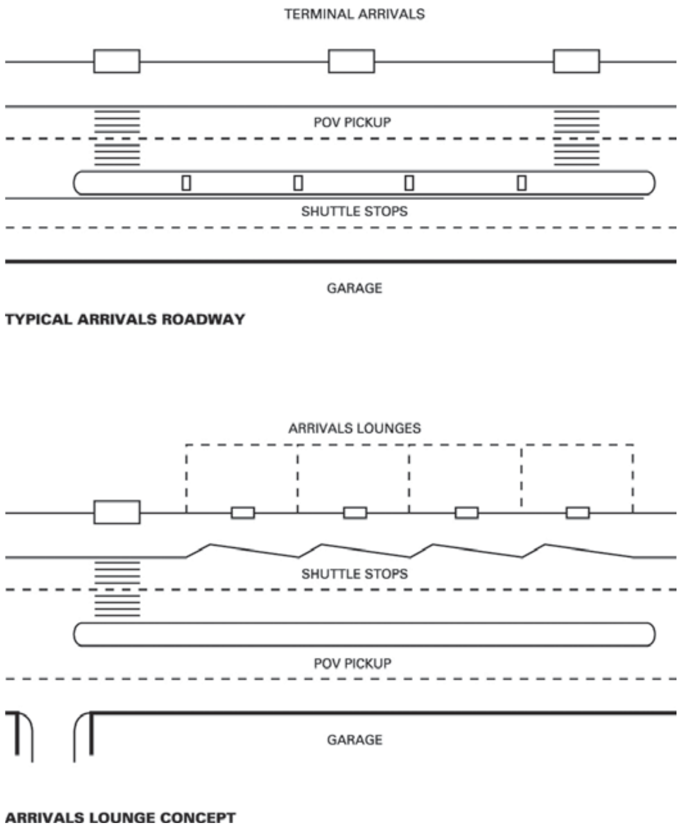

Figure 4-17. Arrivals lounges.

departures lounges. Providing arriving passengers with not only a clean, comfortable place to wait for their desired vehicle, but also the information they need so that they would be able to patronize concessions or use the amenities provided in the arrivals lounges should vastly improve the level of service for arriving passengers.

Examples

The tour bus lounges at London Stansted Airport (see Figure 4-18) are a good example of facilities provided to accommodate arriving passengers. As with many commercial vehicle curbs, the tour bus operations curbside at London Stansted Airport are remote from the terminal building. The tour bus lounges provide protection from the elements, include amenities such as restrooms and vending machines, and provide information displays for each tour bus operator.

Many modern ground transportation centers provide nearly the same level of amenities as arrivals lounges, but are typically inadequate in one or more ways. Ground transportation centers often focus on consolidating ground transportation operations to reduce commercial vehicle fleets and curbside congestion rather than focusing on the level of passenger amenities provided. It is also common for ground transportation centers to be open-air (although some may be protected

Figure 4-18. Tour bus lounges at London Stansted Airport.
Source: Corgan Associates, Inc.

from the direct elements) and to provide only sparse bench seating. Very few provide the same level of amenities as the tour bus lounges at London Stansted Airport.

Assumptions/Prerequisites

There are key assumptions or prerequisites for arrivals lounges to be viable. First, there has to be sufficient commercial vehicle demand to make the provision of arrivals lounges feasible. Another assumption is that the physical layout of the terminal area is conducive to a consolidated commercial vehicles curb and that space can be made available for the lounges. Also, the cooperation of the commercial vehicle operators (e.g., hotels, remote parking, etc.) would be required to provide real-time information on their arrival times. Also, the lounges would function best if CV pick-up is provided on the inner curb. Therefore, with a conventional arrivals roadway, POVs would use the outer curb, which could be considered an advantage since it likely places POV activity adjacent to short-term parking.

Evaluation

Passenger Perspective

The key advantage of arrivals lounges to passengers is a reduction in the anxiety typically associated with waiting for commercial vehicles at a remote curb, especially late at night. Arrivals lounges would provide the necessary information for passengers to make decisions such as whether they have time to use the restroom or get something to eat at nearby concessions. Arrivals lounges would also provide a higher level of perceived safety than is commonly found at commercial vehicle curbs by allowing passengers to wait in enclosed, adequately lit facilities. A potential disadvantage might be increased walking distances, particularly for passengers claiming checked baggage, from the arrivals hall to the arrivals lounges.

Operations Perspective

A key operational advantage of arrivals lounges would be the consolidation of commercial vehicle operations at the curbside. Another advantage might be the opportunity to reduce commercial vehicle fleets through longer headways because passengers would be provided a higher level of service and information while they wait in comparison with simply waiting at the curb. Arrivals lounges may also present additional revenue-generating opportunities through vending or advertising.

One potential disadvantage of arrivals lounges is that the lull in traffic during certain times of the day, similar to departures lounges, may result in low overall utilization. However, if communication between the waiting passenger and the vehicle operator were interactive, the frequency of service could be more closely related to demand, thus reducing the number of commercial vehicle trips.

Challenges to Implementation

The single biggest challenge to implementing the arrivals lounge innovation is the question of who would pay for the facilities. Unlike departures lounges, which are paid for by the airlines through lease agreements, ground transportation operators do not typically pay a facility charge in addition to acquiring the right to operate at the airport. While passenger facility charge (PFC) revenues could conceivably be used to support arrivals lounges, the use of these revenues requires airline approval, which may be difficult to obtain for facilities that benefit arriving passengers rather than departing passengers. Airlines have historically been more focused on the departing passenger's experience because they have the best opportunity to affect the experience of departing passengers. In contrast, airport operators are most concerned about the arriving passenger's experience because the arrivals process is often the arriving passenger's first impression of the local area served by the airport. The decision to provide a higher level of service to arriving passengers may be a service decision rather than a business decision.

Another challenge would be finding adequate space to house the arrivals lounges. At airports where the commercial curb is directly adjacent to the arrivals hall, there may not be surplus space available to construct an arrivals lounge. In addition, ground transportation services are relatively decentralized, with each provider controlling its own schedule and being unaccustomed to providing that information to a common information system. The added cost and time to provide their operating information may be a deterrent.

Summary of Innovations

Each innovation addresses a number of the critical issues discussed in Chapter 3. Table 4-1 summarizes the critical issues that are addressed by each innovation. The intent of this summary is to enable airport operators and airport terminal landside planners or designers to quickly identify which of the innovations would be most relevant to the situations at a particular airport. While the innovations were discussed individually in this chapter, combining one or more innovations could enhance their effectiveness. Several options for combining the innovations are discussed in Chapters 5 and 6.

Table 4-1. Summary of issues addressed by each innovation.

	Issues					
Innovation	Waiting / Queuing	Walking / Vertical Transitions	Baggage Handling by Passengers	Information / Signage / Wayfinding	Vehicular Movement / Pickup / Drop-off	Safety and Security
Process-based departures hall	●			●	●	
Passenger-processing facilities	●	●	●	●	●	●
Self-service baggage check	●					
Bag-check plaza	●	●	●		●	●
Supplemental curbside		●	●		●	●
Passenger assistance parking		●	●		●	●
Low-profile passenger baggage devices			●			●
High-capacity flow-through elevators		●	●			●
Consolidated meeters-and-greeters area	●	●	●	●		●
Arrivals lounges	●		●	●	●	●

● Issue is addressed by innovation

CHAPTER 5

Landside Concepts

Based on a review of the innovations described in Chapter 4, several passenger-processing concepts were developed to illustrate the general process that a departing or arriving passenger could experience while traveling through the airport landside environment. For the purpose of this research project, three landside concepts were developed, incorporating innovations discussed in Chapter 4, to illustrate the passenger experience and range of activities that would occur from the point the passenger enters the airport property in a vehicle (e.g., POV, CV, or public transport) until the point where the passenger arrives at the face of the terminal. The facilities that illustrate the three general concepts and processes described in the following sections are defined as:

- Adjacent passenger-processing facilities (APPF);
- On-airport passenger-processing facilities (OPPF); and
- Remote passenger-processing facilities (RPPF).

Adjacent Passenger-Processing Facilities

The APPF concept is envisioned to accommodate vehicle parking and curbside facilities in proximity to, but not necessarily attached to, the terminal (departures hall, SSCP, baggage claim, etc). A primary component of the APPF would be a new or existing parking structure that accommodates various functions intended to improve customer service and to increase the efficiency of landside operations. These functions could include innovations such as the bag-check plaza, a supplemental curbside, and a passenger assistance parking area. APPF could also serve as a central hub for other facilities, such as regional transit and consolidated rental car facilities. Various alternatives for APPF are described below.

Alternatives

It is anticipated that an APPF concept could consist of an unlimited number of features and configurations that would be dependent upon numerous variables. These variables include, but are not limited to, the goals of the airport operator and other stakeholders, budgetary constraints, and compatibility with existing facilities. The alternatives would be applicable to a wide variety of airport sizes, with the exception of Alternative 4: because of its complexity and number of functions, Alternative 4 is more suited to implementation at larger airports. The five APPF concept alternatives are described below.

Alternative 1

The primary components related to the departing passenger's experience in Alternative 1 include a bag-check plaza located prior to entering the central terminal area and POV passenger drop-off in the adjacent parking structure. As shown in Figure 5-1, passengers in POVs would check their baggage at the bag-check plaza and proceed to the supplemental curbside located on an elevated level of the parking structure to drop off their passenger(s) and either park or exit the structure. Passengers would then proceed to an elevated walkway crossing to the terminal building and then down an escalator to the departures hall.

For arriving passengers, the POV supplemental curbside would be located at grade level in the adjacent parking structure. Passengers would exit baggage claim and cross the CV curbside roadway to the POV pickup curbside located in the adjacent parking structure. CV drop-off and pickup curbsides would remain adjacent to the terminal building.

Alternative 2

Alternative 2 (see Figure 5-2) would provide departing passengers with a bag-check plaza; however, unlike Alternative 1, POV passenger pickup and drop-off would be accommodated adjacent to the terminal while CV passenger pickup and drop off would be located at a supplemental curbside on an elevated level of the parking structure.

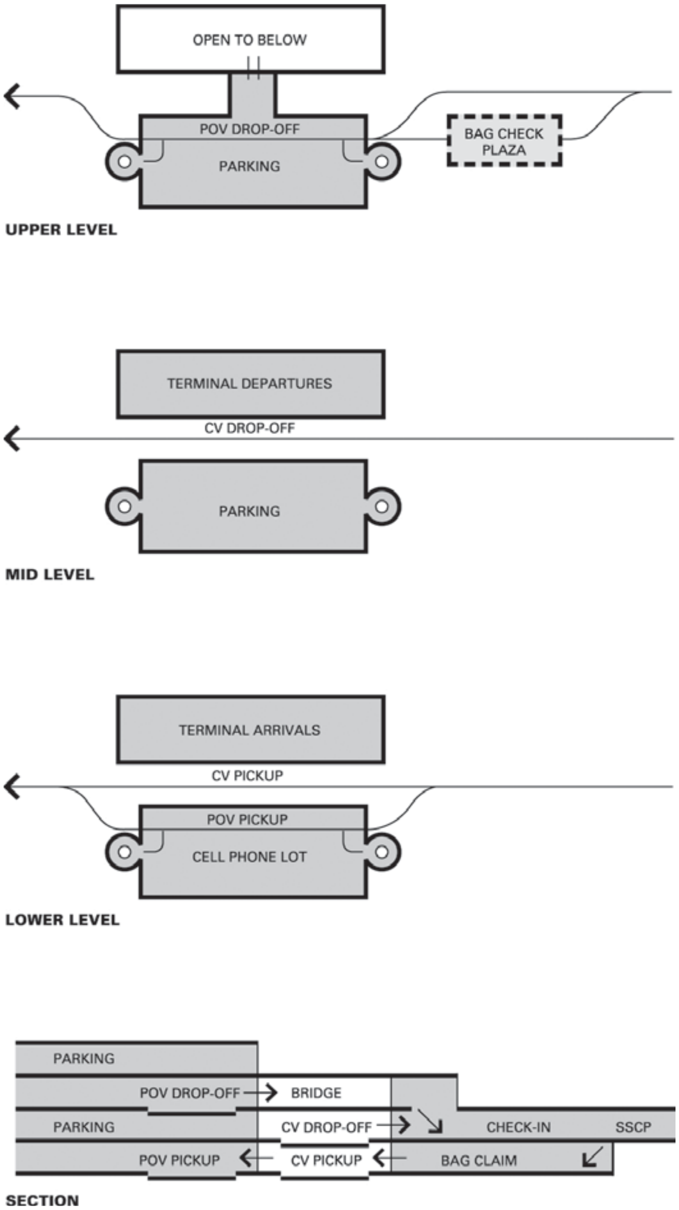

Figure 5-1. APPF Alternative 1.

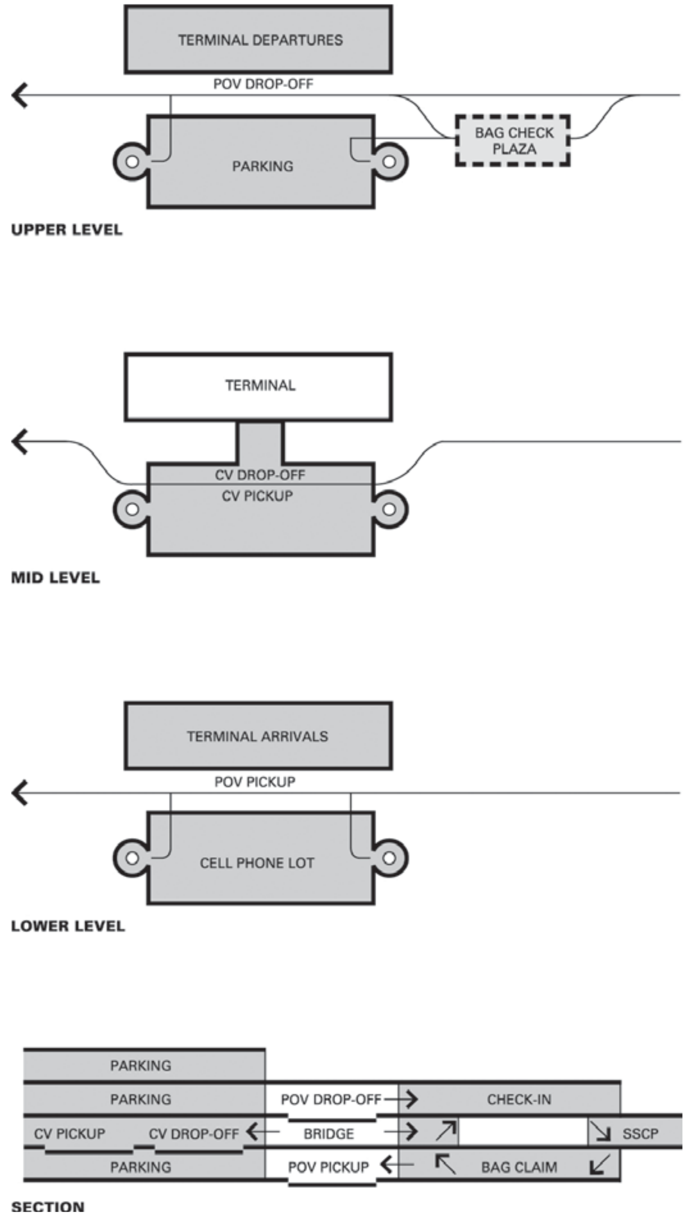

Figure 5-2. APPF Alternative 2.

Departing CV passengers would take an elevated walkway crossing to the terminal building and then take an escalator up to the departures hall. Arriving CV passengers would retrieve their baggage and proceed up an escalator and across the elevated walkway to the curbside.

Alternative 3

Alternative 3 would accommodate all departing passengers in the parking structure. As illustrated in Figure 5-3, POV passenger drop-off would be located at a supplemental curbside on an elevated level of the parking structure while CV passenger drop-off and pickup would be accommodated at grade level. POV passengers would take an elevated walkway crossing into the departures hall while CV passengers would take an escalator located in the parking structure up one level to the elevated walkway crossing into the departures hall.

Arriving POV passengers would be accommodated at grade level adjacent to the terminal. Arriving CV passengers would be accommodated in the same location as departing CV passengers. Passengers would proceed out of baggage claim and cross the POV curbside roadway to the CV curbside located in the parking structure.

Alternative 4

In Alternative 4 (see Figure 5-4), the passenger-processing facility would provide a wider range of functions, essentially replacing many functions that would be conventionally

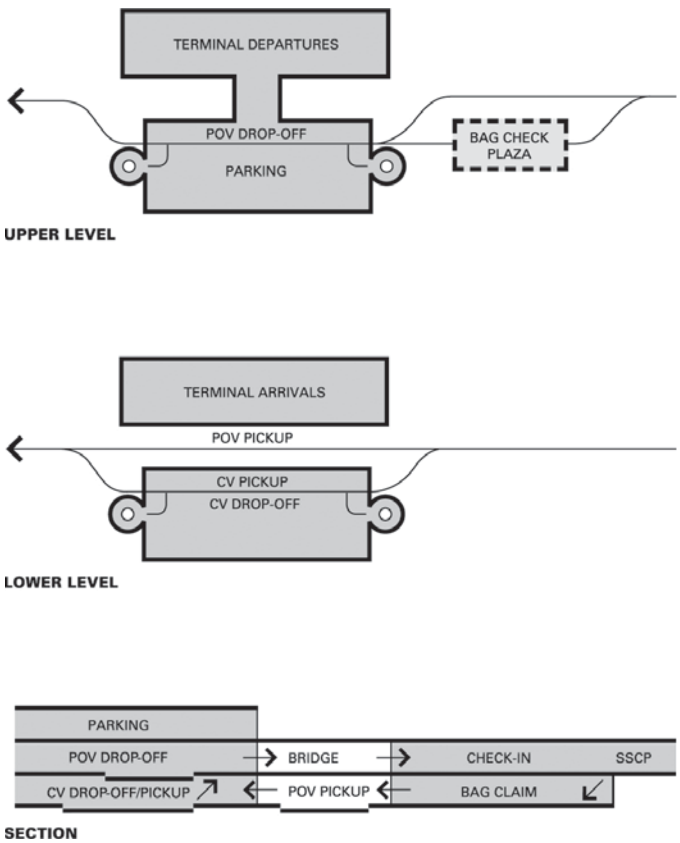

Figure 5-3. APPF Alternative 3.

located within the terminal building. POVs and CVs carrying departing passengers would be inspected at a vehicle checkpoint before proceeding to the main support facility (or parking structure) for drop-off and check-in. Passengers would then take an elevated walkway crossing to the terminal building. At the terminal building, passengers would be screened at the SSCP and proceed to their gate.

POV drop-off and pickup would be provided on the same level within the parking structure. It is, therefore, anticipated that all POVs would require inspection because they would be entering a facility (and potentially parking) where substantial passenger-processing functions would take place, involving relatively large numbers of people. After inspection, POVs would proceed either through the bag-check plaza or directly into the support facility for passenger drop-off and potentially parking. To avoid vehicle/pedestrian conflict, departing passengers would then proceed via elevator or escalator up to the check-in facilities. Arriving passengers would claim their baggage in the terminal, but all other services, including POV and CV passenger pickup, would be accommodated in the adjacent parking structure. Arriving passengers who are to be picked up by a POV could proceed directly to the curbside on the arrivals level or, if they are to access a CV, take a high-capacity flow-through elevator down to the CV curbside for pickup.

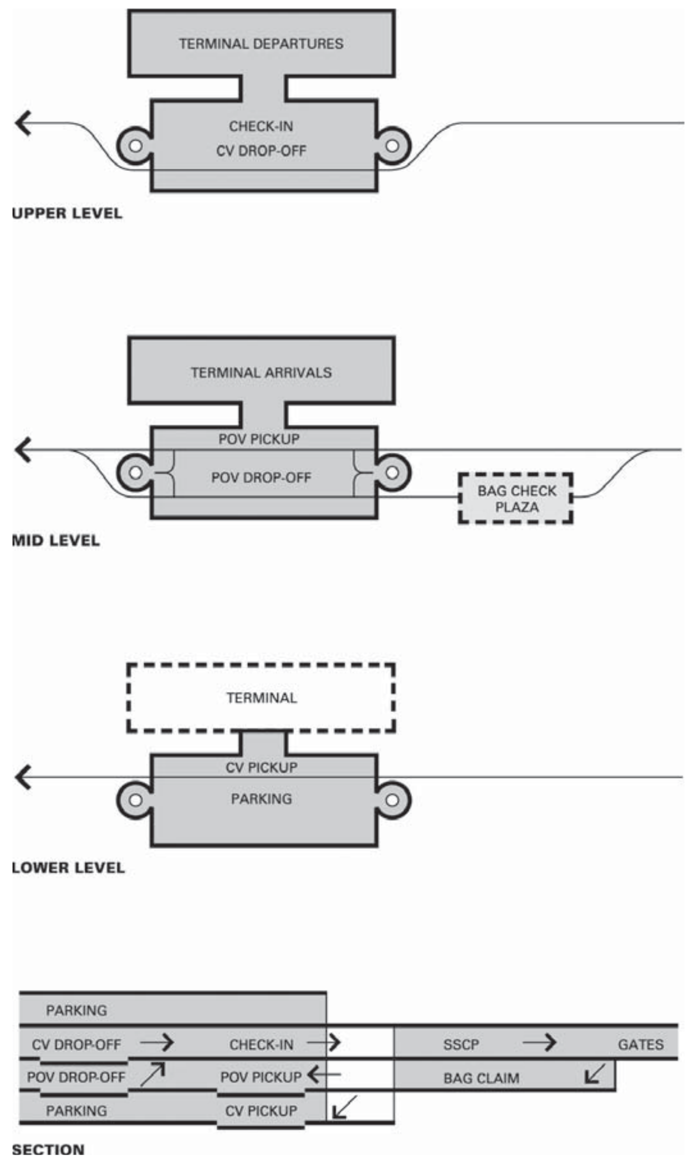

Figure 5-4. APPF Alternative 4.

CV passenger drop-off would be provided on the level immediately above POV passenger drop-off, at the same elevation as the terminal departures level. CV passengers would have the opportunity to check their baggage using either SSDs or full-service counters at this level and would proceed into the terminal to the SSCP. Upon retrieving their baggage, arriving passengers would take an elevator or escalator down one level to the arrivals curbside.

Alternative 5

Alternative 5 would accommodate all passenger pickup and drop-off functions in a facility adjacent to the terminal. As shown in Figure 5-5, departing passengers using POVs and CVs would be accommodated on a supplemental curbside on an elevated level of the parking structure. Passengers would

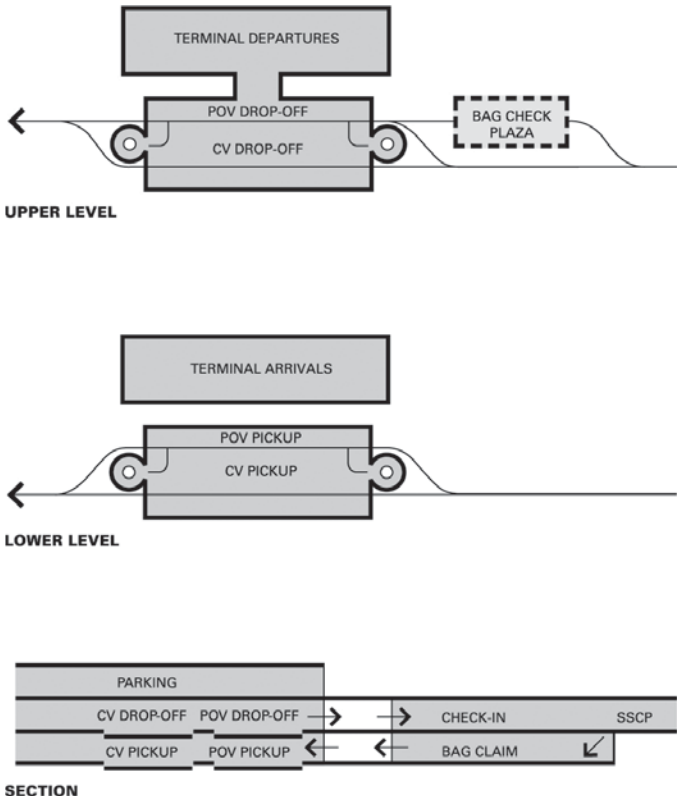

Figure 5-5. APPF Alternative 5.

then take an elevated walkway crossing directly into the departures hall. Arriving passengers using POVs and CVs would be accommodated on a supplemental curbside on grade level in the parking structure. After retrieving their baggage, passengers would proceed out of the terminal building and across a courtyard to the parking structure. This alternative essentially creates a "remote curb" terminal building.

Common Advantages

A common advantage among all of the APPF alternatives is the ability for departing passengers to check baggage prior to parking or being dropped off, which relieves passengers of handling their baggage and reduces congestion on the curbside and in the departures hall. Another common advantage is the ability to drop passengers off at the supplemental curbside located in the garage, which relieves congestion on the terminal roadway system and allows park-and-fly passengers to drop their companions prior to parking. Also, vertically separated supplemental curbsides would reduce vehicle/pedestrian conflicts. Alternative 4 would provide major congestion relief for an existing terminal, enabling it essentially—on the departures side—to become a secure building, which could provide an improved departures environment and enhanced revenue-producing concession opportunities.

Common Disadvantages

A common disadvantage among the APPF alternatives is that the facilities would be constructed in what is likely an already congested central terminal area, which would result in high construction costs and potentially significant operational disruptions. In the case of Alternative 4, it may be that a support facility of this scope would replace too many terminal functions, leading to large amounts of redundant space and roadway capacity. Because more passenger processing would be occurring in an adjacent facility, each alternative may result in longer walking distances because passengers are required to cross a roadway or take an elevated walkway crossing to reach their desired locations. Alternative 4 would likely require that POVs and CVs be inspected because of the large numbers of pedestrians in the facility, which would involve passenger inconvenience and increased operating costs.

Alternatives Evaluation

Two sets of criteria were developed to evaluate the alternatives. The first set of criteria relates to passengers; the second set of criteria relates to feasibility of implementation. Table 5-1 sets forth the specific criteria and the corresponding benefits of each APPF alternative.

Passenger Criteria

The use of a supplemental curbside in an adjacent facility or parking structure would likely increase walking distances in all of the APPF alternatives. Passengers accustomed to all curbside functions being directly adjacent to the terminal building will experience a reduced level of service as they will have to walk between the supplemental curbside in the garage and the terminal building.

The majority of commercial service airports require at least one level change regardless of the desired ground transportation mode. In many cases, more than one level change may be required. None of the APPF alternatives requires more than one level change. In many cases, the level change is provided to avoid vehicle and pedestrian conflicts.

The bag-check plaza would significantly increase the benefit of all APPF alternatives by relieving POV passengers from carrying their baggage from their parked vehicle into the terminal building. This would be especially beneficial to elderly and disabled passengers.

Wayfinding under APPF Alternatives 1, 2, and 3 would become less intuitive as a result of the addition of a supplemental curbside in the adjacent facility or parking structure. Alternative 3, for example, would accommodate POV passenger drop-off in the support facility and POV passenger pickup adjacent to the terminal. The vertical, as well as horizontal,

Table 5-1. APPF alternatives evaluation matrix.

	APPF Alternatives				
	1	2	3	4	5
Passenger criteria					
Walking distances	—	—	—	—	—
Number of level changes	●	●	●	●	●
Baggage handling by passengers	●	●	●	●	●
Wayfinding	○	—	○	●	●
Safety / security	○	○	●	●	●
Feasibity criteria					
Capital cost of implementation	●	●	○	○	○
Revenue generation potential	●	—	○	●	●
Operational considerations	●	○	●	●	●
Environmental	●	○	○	—	—
Security considerations	●	—	○	—	—

● Significant benefits
○ Marginal benefits
— No considerable benefit

separation of curbside facilities could confuse drivers as well as pedestrians as they try to locate their desired terminal roadway or curbside. However, this issue could be remedied by ensuring that adequate signage is in place. Alternatives 4 and 5 resemble a more traditional terminal roadway entrance as curbsides would be vertically separated.

Alternatives 1 and 3 would provide a safer environment for pedestrians as vehicle and pedestrian conflicts would be eliminated for departing and arriving passengers. Because of the proximity of passenger-processing functions such as check-in and baggage claim, security would be a major factor with Alternative 4. Vehicles would have to be inspected prior to entering the facility.

Feasibility Criteria

The cost to implement any of the APPF alternatives would likely be significant. As mentioned in Chapter 4, the physical limitations of existing facilities (e.g., column spacing and inadequate floor-to-ceiling height) would limit the ability to retrofit an existing parking structure to accommodate curbside facilities—as incorporated in Alternatives 1, 2, and 3—and could make the project very expensive. However, it should be noted that accommodating terminal functions in a garage-type facility should decrease the need to expand a potentially more expensive terminal building with less disruption to operations. As mentioned in the description of the alternatives, Alternative 4 would provide a wider range of functions than would normally be located in the terminal. Renovation of an existing facility or parking structure would, therefore, not likely be required. A new facility would have to be constructed, which would require a considerable capital investment and potential disruption of an existing operation.

The ability to generate minimal additional revenue could result where a supplemental curbside provides space for additional ground transportation services or providers that would otherwise be unable to be accommodated. Accommodating these additional services or providers could, therefore, increase the fees paid to the airport. Under Alternative 4, more passenger-processing functions would be located in the adjacent facility, which would provide an opportunity to accommodate additional concessions in the adjacent facility.

The use of a supplemental curbside in Alternatives 1, 2, and 3 would provide not only additional curbside capacity, but also the ability to further separate mode types, which would provide less mixing of POVs and CVs. As mentioned above, the supplemental curbside would also allow for a reduction in vehicle/pedestrian conflicts.

APPF Alternatives 1, 2, and 3 could require renovation of existing facilities while they remain in operation, which would be challenging. The construction of a supplemental curbside would disrupt the existing parking operation and could impact existing roadway operations. Alternative 4 would require the construction of a new facility and, depending on its location, would have a much lower impact on existing operations.

As noted in Chapter 4, one of the advantages of the bag-check plaza is that it reduces curbside roadway congestion associated with curbside check-in. This reduction in the number of vehicles idling on the curbside roadways would also decrease vehicle emissions. On the other hand, there would be the potential difficulty and cost associated with delivering the bags from the check-in facility to the terminal baggage system.

APPF Concept Example

The APPF concept example (see Figures 5-6 through 5-8) is functionally similar to APPF Alternative 1. Figure 5-6 shows how this concept would inter-relate with three common terminal and roadway configurations. As shown in the section illustrated in Figure 5-6: "Two Level Terminal and Roadway," this concept would provide vertical separation of POV passenger drop-off and pickup activities in an adjacent parking structure.

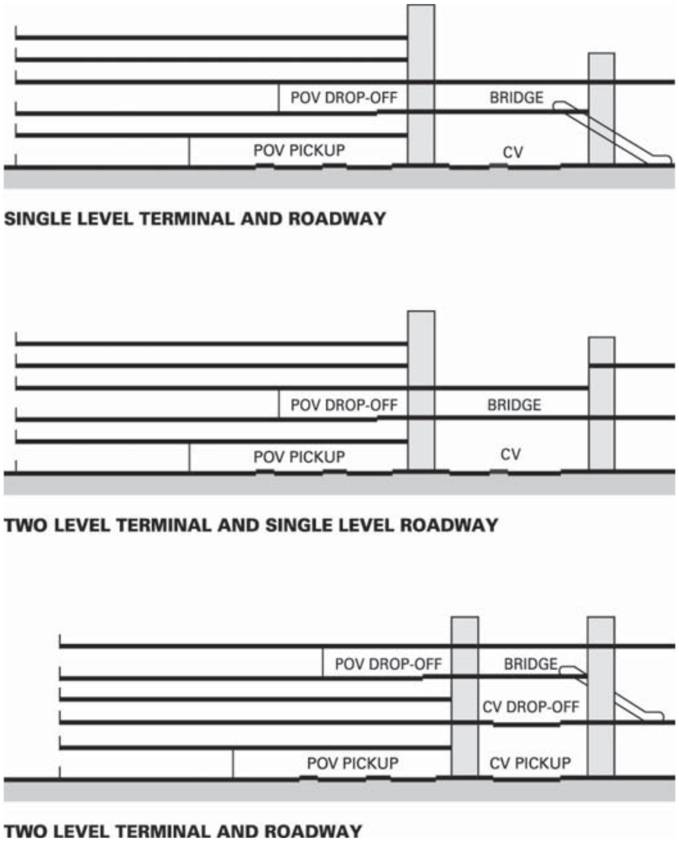

Figure 5-6. APPF concept example—section.

POV departing passenger drop-off would occur on an upper level of the structure, and POV arriving passenger pickup would be accommodated on a lower level. In this example, CV passenger pickup and drop-off would be accommodated at the terminal building curbside. The POV passenger drop-off area would be connected directly to the terminal via a pedestrian bridge. The elevation of the pedestrian bridge and the location of the POV curbsides would vary depending upon the configuration of the terminal building and curbside roadway system.

The APPF conceptual layout of the upper-level facilities is shown in Figure 5-7. POVs destined for the passenger drop-off areas would have the option of accessing the bag-check plaza to check-in for their flight and drop off their baggage. POVs would then proceed to the supplemental curbside located in the parking structure for passenger drop-off. In this example, a passenger assistance parking area accessed directly from the POV passenger drop-off curbside is provided to accommodate passengers desiring assistance in unloading (limited to 10- to 15-min dwell times). In addition, direct access to a short-term parking area (e.g., 1-hr parking) is also provided via the POV passenger drop-off roadway. Close-in parking on other levels of the garage could also be accessed directly, giving vehicle drivers the opportunity to drop off their passengers and proceed directly to parking or to exit the terminal area. Park-and-fly passengers would proceed directly to parking or, if they have bags to check, to the bag-check plaza and then to parking.

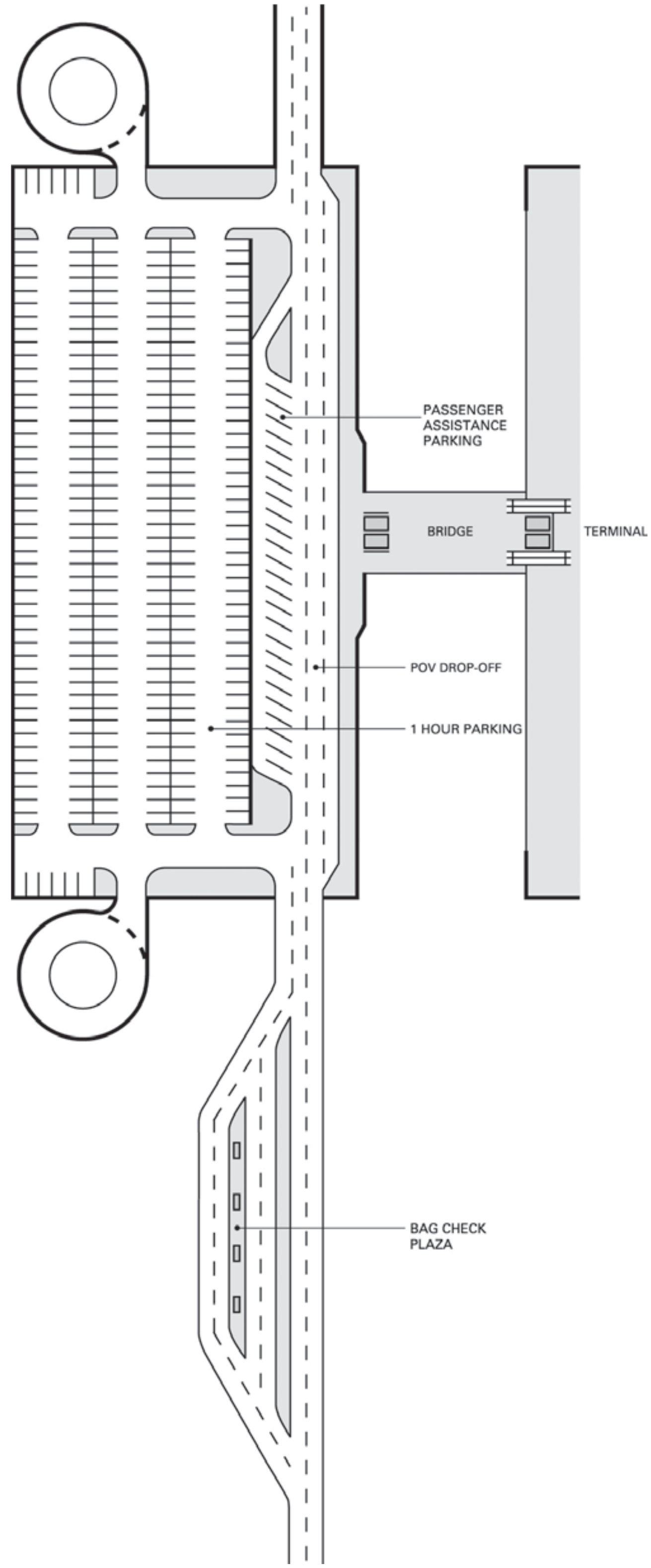

Figure 5-7. APPF concept example—upper level.

The APPF conceptual layout of the lower-level facilities is depicted in Figure 5-8. Similar to the upper-level, a POV passenger pickup curbside would be provided along a linear curbside within the structure. A passenger assistance parking area would also be provided, accessible via the POV curbside

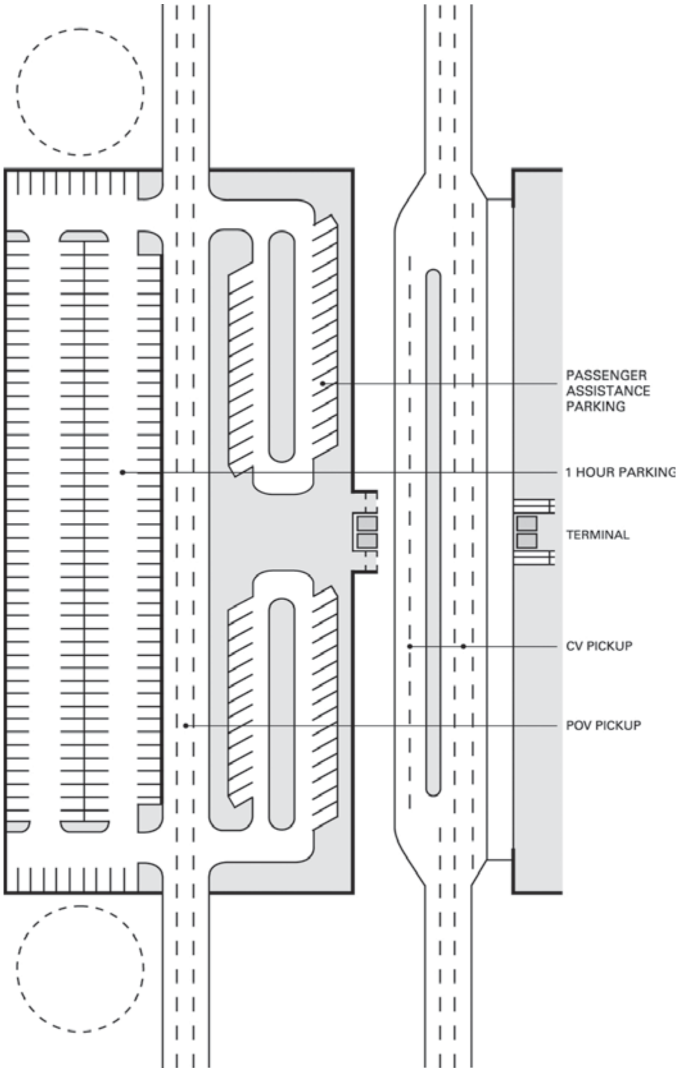

Figure 5-8. APPF concept example—lower level.

roadway. In this layout, passengers using the passenger assistance parking area would not have to cross traffic lanes to access the terminal. One-hour parking is also provided at this level for meeters and greeters who wish to meet their parties inside the terminal. As shown in Figure 5-8, CV passenger pickup would be accommodated along the curbside roadway fronting the terminal building.

On-Airport Passenger-Processing Facilities

Under the OPPF concept, the vehicle parking and curbside facilities would be integrated with a range of terminal functions in a facility on the airport, but at some distance from the terminal building and connected by a passenger conveyance system. Passengers would park and be processed in the same facility before taking a conveyance system to the secure portion of the terminal building. In addition to terminal functions, because of its location flexibility, the OPPF could effectively accommodate an integrated rental car facility or a regional transit connection.

Alternatives

As with the APPF, it is anticipated that an OPPF concept could consist of an unlimited number of features and configurations that would be dependent upon numerous variables. These variables include, but are not limited to, the goals of the airport operator and other stakeholders, budgetary constraints, and compatibility with existing facilities. The OPPF alternatives would be applicable to a wide variety of airport sizes, with the exception of OPPF Alternative 3, which is more suited to implementation at larger airports. The passenger-processing functions included in each of the three OPPF alternatives are described below.

Alternative 1

Of the three OPPF alternatives, Alternative 1 (see Figure 5-9) would provide the fewest passenger functions. A bag-check plaza would be provided for departing passengers. Park-and-fly passengers would then proceed to parking and take a non-secure transit system to the terminal. POV passengers who are being dropped off could be accommodated in the OPPF or be dropped off directly at the terminal. Passengers wishing to be picked up by POVs or CVs would be picked up at the terminal building. Those passengers who parked at the OPPF would return to the OPPF via the transit system and would then proceed to their vehicles.

Alternative 2

OPPF Alternative 2 (see Figure 5-10) would provide the same functions as OPPF Alternative 1 for POV passengers, as

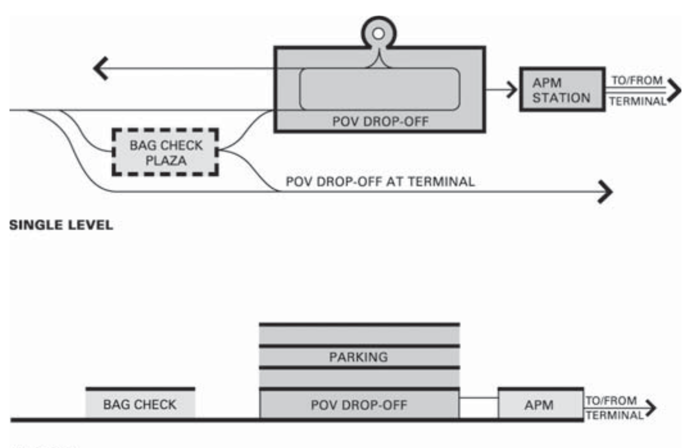

Figure 5-9. OPPF Alternative 1.

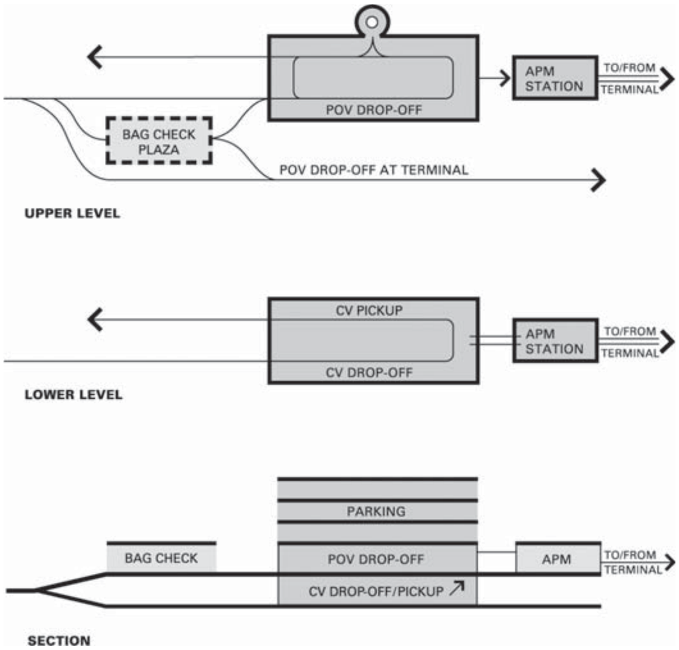

Figure 5-10. OPPF Alternative 2.

well as additional curbside facilities to allow CV passenger pickup and drop-off at the facility—essentially creating a ground transportation center with parking and an APM connection to the terminal.

Alternative 3

OPPF Alternative 3 (see Figure 5-11) represents a fully developed on-airport landside support facility with a secure APM connection to the secure portion of the terminal. Departing passengers would begin with POV inspection, then continue to the bag-check plaza, and then to the OPPF, which would provide for both POV and CV passenger drop-off. Departing passengers would then proceed to the SSCP and the integrated APM station to the terminal. Arriving passengers would take the secure APM connection from the secure portion of the terminal to the OPPF and then proceed into the baggage-claim hall and to the POV and CV passenger pick-up area and parking.

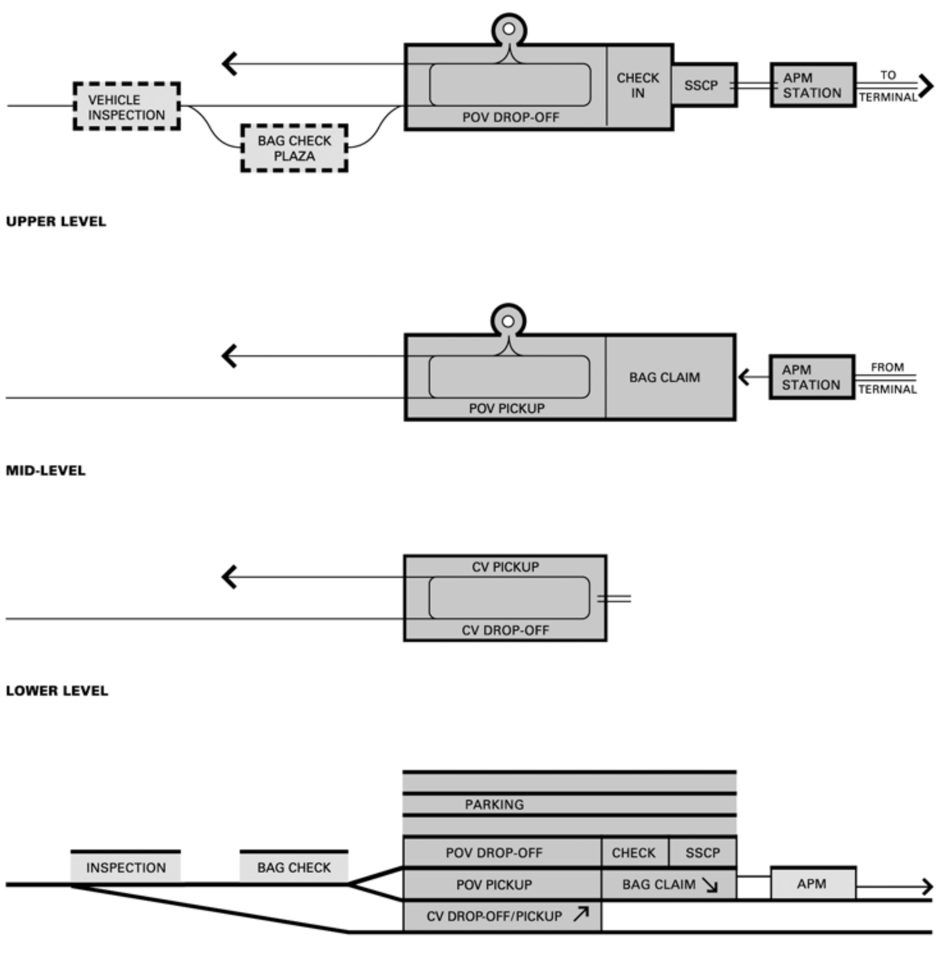

Figure 5-11. OPPF Alternative 3.

Common Advantages

The primary advantage of the OPPF concept and the OPPF alternatives is the flexibility of the facility's location relative to the airside. The site could be selected on the basis of airport circulation, constructibility, land cost, and accessibility to regional transit or suitability for rental car operations without having to provide direct access to the secure portion of the terminal. The OPPF alternatives would avoid the operational and cost impacts of building in a congested central terminal area, which could offset some of the costs for a required transit connection. Functions provided as part of OPPF Alternative 3 would greatly reduce the departures hall requirements and eliminate the need for a baggage-claim hall in the terminal building.

Common Disadvantages

The disadvantages of the OPPF concept include the need for a transit connection, which would incur costs and the potential difficulty of establishing a right-of-way. A similar disadvantage would apply to connecting check baggage to the terminal baggage system. With OPPF Alternatives 1 and 2, passengers who claim their baggage at the terminal building would have to carry their baggage on the transit connection back to their parking location.

Alternatives Evaluation

Similar to the APPF, two sets of criteria were developed to evaluate each OPPF alternative. The first set of criteria relates to passengers; the second set of criteria relates to feasibility of implementation. Table 5-2 sets forth the specific criteria and the corresponding benefits of each OPPF alternative.

Table 5-2. OPPF alternatives evaluation matrix.

	OPPF Alternatives		
	1	2	3
Passenger criteria			
Walking distances	—	—	—
Number of level changes	—	—	—
Baggage handling by passengers	○	○	—
Wayfinding	○	—	○
Safety / security	○	○	●
Feasibility criteria			
Capital cost of implementation	●	●	○
Revenue generation potential	●	—	○
Operational considerations	●	○	●
Environmental	●	○	○
Security considerations	●	—	○

● Significant benefits
○ Marginal benefits
— No considerable benefit

Passenger Criteria

A fully integrated landside support facility where all passenger functions such as parking and check-in facilities are vertically separated would have the ability to reduce walking distances for those parking in the facility. However, depending upon the layout of the OPPF and the proximity of the curbside to the APM station, walking distances could be substantial.

While vertical separation of passenger functions would assist in reducing walking distances, the number of level changes would likely increase. OPPF Alternative 3 would require the highest number of level changes. Ensuring an adequate number of elevators or escalators to transport passengers between their desired levels would, therefore, be a critical and required component of this concept.

While the bag-check plaza would relieve passengers from carrying their baggage from their parked vehicles into the terminal building, OPPF Alternatives 1 and 2 would require arriving passengers to handle check baggage on the passenger conveyance system when returning to parking. OPPF Alternative 3 would provide check-in in the OPPF, minimizing the distance passengers would have to handle their baggage.

The ease of wayfinding would be dependent upon the number of functions provided in the OPPF. If the facility were to be used to supplement an existing terminal, passengers may have difficulty determining the location that best suits their needs.

Each of the OPPF alternatives is intended to provide a safer environment for pedestrians as vehicle/pedestrian conflicts would be minimized for departing and arriving passengers. As passenger-processing functions such as check-in and baggage claim would be included, potentially involving large concentrations of passengers, security could be a major factor in OPPF Alternative 3. Therefore, it would likely be necessary to inspect every vehicle prior to it entering the facility.

Feasibility Criteria

The cost savings of building an OPPF as opposed to expanding an existing terminal would depend on the location and functions included in the OPPF. A facility consisting of a parking structure and passenger drop-off facilities, such as OPPF Alternative 1, would cost less than a more comprehensive facility, such as that in OPPF Alternative 3. However, use of the transit connection to the terminal would be lower in OPPF Alternative 1 although ridership could be increased if rental car return or a regional transit station were included in the facility. The proximity of the OPPF to the existing terminal and the subsequent length of passenger and baggage conveyance systems would also affect the overall cost of the facility.

The OPPF would provide the opportunity to generate new revenue by increasing parking supply and services available in the remote facility, as well as new concessions. This provision of additional capacity would also allow an airport operator to recapture parking demand and associated revenue that had been lost to off-airport parking providers.

Integration of the functions that would be provided in the OPPF and the existing terminal would require considerable attention. Passengers accustomed to a single passenger-processing facility would need to be educated as to the location of services that may now be provided at one or two possible locations (e.g., the terminal); however, this issue could be addressed by creating effective wayfinding and signage.

The complexity of implementing the OPPF would depend on where the facility is to be located. A major advantage of the OPPF is its location flexibility, which should allow the selection of a buildable site with good construction access and minimal disruptions to ongoing operations.

Operationally, increasing the capacity of landside facilities may reduce traffic recirculation; however, additional capacity may also increase the number of vehicles accessing the airport. Also, the location of the OPPF may require the introduction of shuttle services to access both facilities, thereby increasing the overall number of vehicle trips and emissions.

OPPF Concept Example

The OPPF concept example (see Figures 5-12 and 5-13) provides a more detailed representation of OPPF Alternative 2. This example includes a two-level facility with POV passenger pickup and drop-off occurring on the upper level of a parking structure and CV passenger pickup and drop-off occurring on the lower level.

The upper level OPPF configuration is depicted in Figure 5-12. Similar to the APPF concept example, POVs destined for the passenger drop-off curbside would have the option of stopping at a bag-check plaza, proceeding directly to the drop-off curbside in the facility, or proceeding to the terminal. A passenger assistance parking area, as well as a short-term parking area, would be provided on the upper level. Park-and-fly passengers could proceed directly to parking. A POV passenger pickup curbside accessible via the same inbound roadway system, or from the parking above, would be provided on the opposite side of the parking garage. Passengers would be transported to the terminal via a non-secure people mover.

The lower-level OPPF configuration is depicted in Figure 5-13. As shown, a shuttle drop curbside and staging area with islands would be provided to accommodate passenger

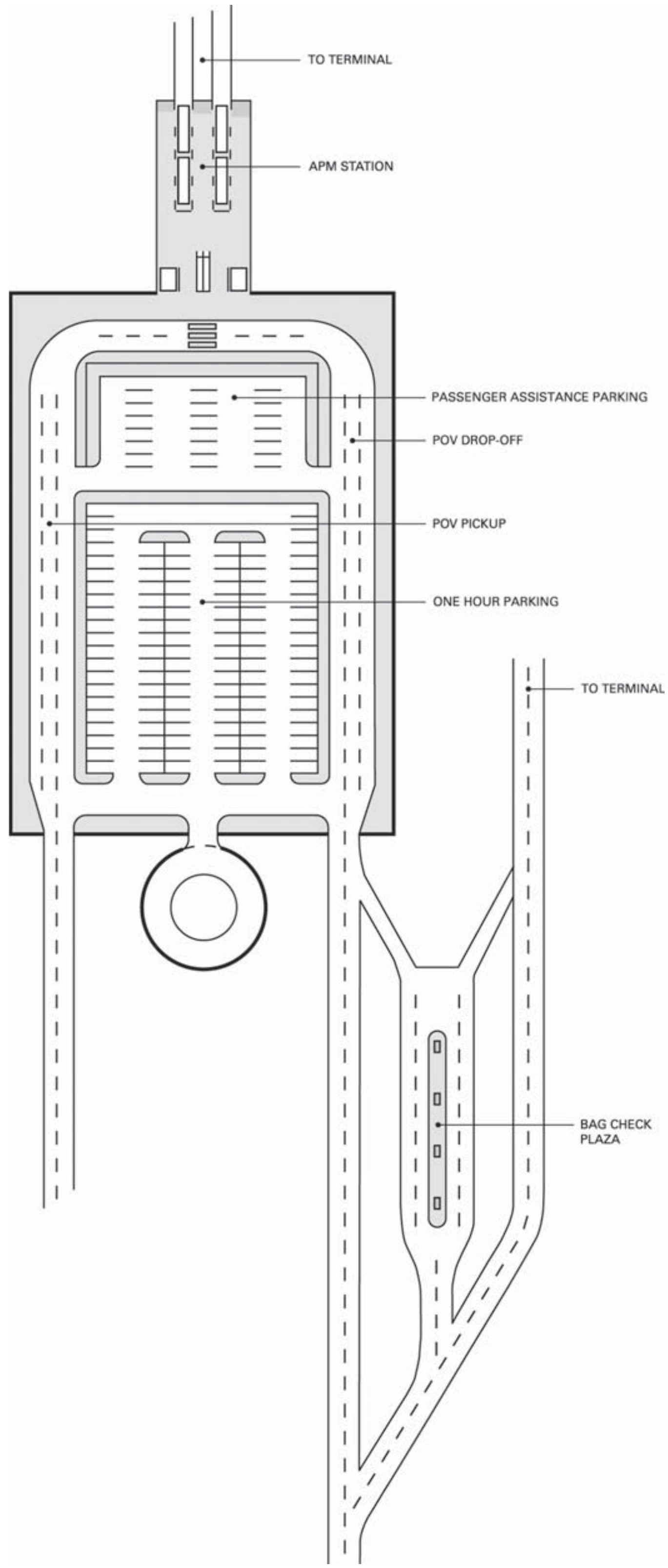

Figure 5-12. OPPF concept example—upper level.

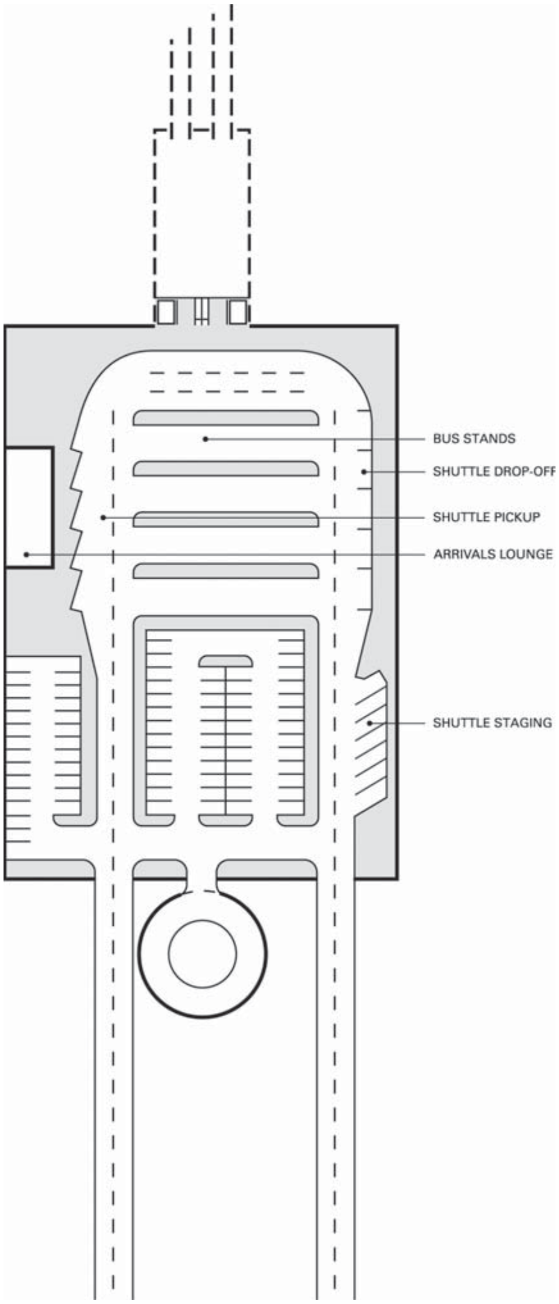

Figure 5-13. OPPF concept example—lower level.

drop-off and pickup. An arrivals lounge is depicted adjacent to the shuttle-bus pickup curbside. As described in Chapter 6, the lounge would provide a comfortable passenger waiting environment with video monitors to relay real-time information on shuttle arrival times and parking locations.

Remote Passenger-Processing Facilities

The RPPF involves a remote passenger-processing facility that would be located off airport property, possibly in an urban location or some other heavily populated location that offers transit connectivity. Because of the remote location of these facilities, they would likely provide fewer passenger-processing functions. Although these types of facilities have had some success in Europe and Asia, the decentralized nature of the regional transportation network in the majority of U.S. cities may not be as conducive to implementation of RPPFs. ACRP Project 10-02, "Planning Guide for Offsite Terminals," provides guidance for determining the feasibility of an off-airport remote terminal. Therefore, this research project will focus on potential concepts for those remote facilities assuming that their feasibility has already been established.

Alternatives

The RPPF alternatives include a range of potential services and would primarily be applicable to airports in cities where there is an established regional transportation network and sufficient demand to justify connection to the airport. The passenger-processing functions that would be included in each RPPF alternative are described below.

Alternative 1

RPPF Alternative 1 (see Figure 5-14) would provide a basic remote location where passengers could board a non-secure link to the airport. A relatively simple support facility would be provided with a waiting room and boarding pass kiosks. Passengers would also be able to park their vehicles or be dropped off at the RPPF. It is envisioned that the RPPF would also connect with the local or regional transit system.

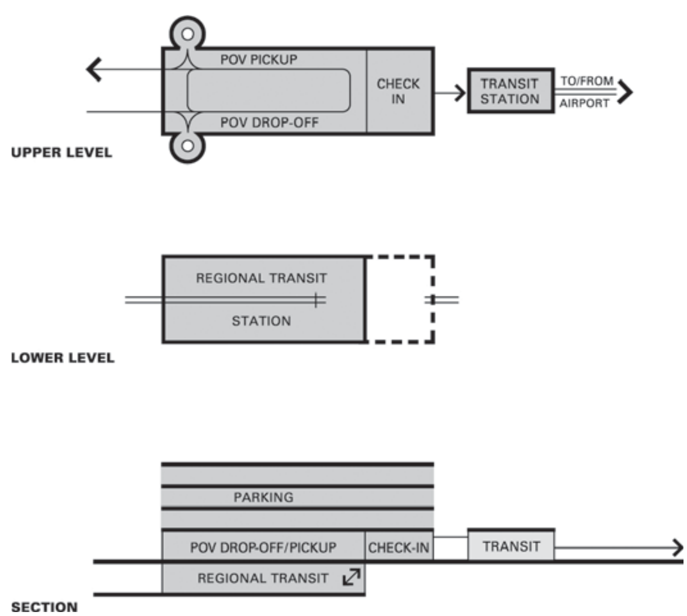

Figure 5-14. RPPF Alternative 1.

Alternative 2

RPPF Alternative 2 (see Figure 5-15) is a full-service remote terminal that would provide the opportunity to check baggage and use full-service check-in functions. An SSCP would also be provided; therefore, a secure link to the terminal would need to be provided, which could also be used to transfer outbound and inbound baggage. Regional transit could be accommodated on a lower level with self-service check-in and bag drop.

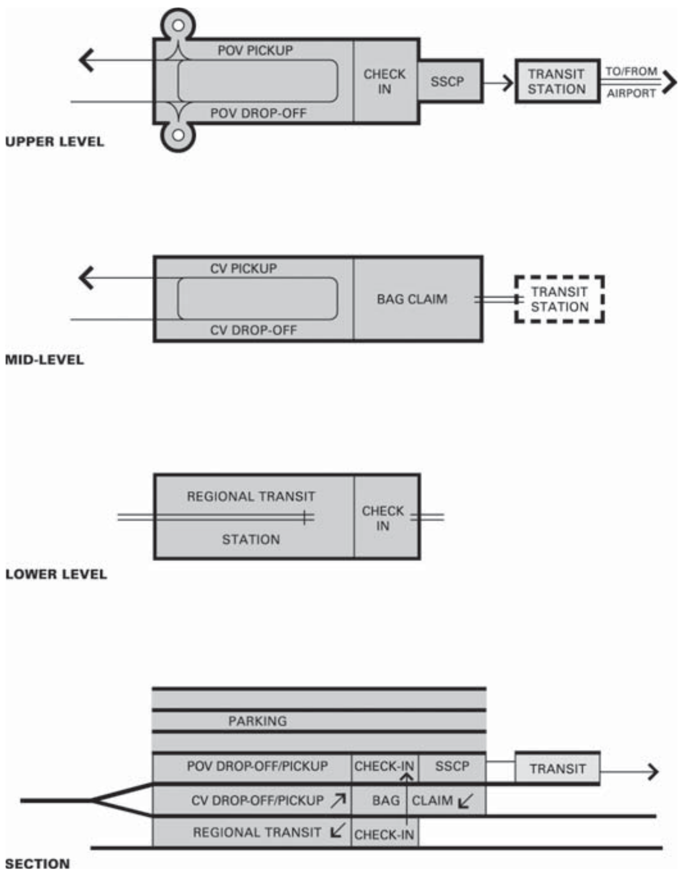

Figure 5-15. RPPF Alternative 2.

RPPF Concept Example

The RPPF concept example (see Figure 5-16) provides a more detailed representation of RPPF Alternative 1. The example represents an RPPF where passengers could park their vehicles or use other transportation modes (e.g., public transit, taxicabs) to access the facility. At the RPPF, passengers could obtain boarding passes and check their baggage before boarding a train or bus providing direct service to the airport. As shown in Figure 5-16, the passenger-processing facilities and curbside facilities would be provided on the lower level of a parking structure, with public parking provided above these facilities. A linear curbside would be provided for POV and taxicab and other CV passenger pickup and drop-off. Passengers would walk through a ticket lobby and services/concessions area to reach a rail platform, where they could board a train that would transport them to the airport. This function is shown on the same level as the other functions, but could be accommodated on an upper or lower level. Short-term (1-hr) parking would be provided on the lower level of the RPPF, adjacent to the passenger-processing facilities. A regional transit or subway station could be accommodated on a lower level (not shown).

Landside Concept Considerations

Discussed in this section are the key physical and nonphysical airport attributes that should be considered by airport operators and terminal landside planners when identifying landside concepts for further consideration. A summary (see Table 5-3) is provided to further compare these attributes and the general level of importance of an attribute in influencing the desirability and likely success of a landside concept. Airport attributes that should be considered when developing a landside concept are summarized in two categories—physical attributes and nonphysical attributes.

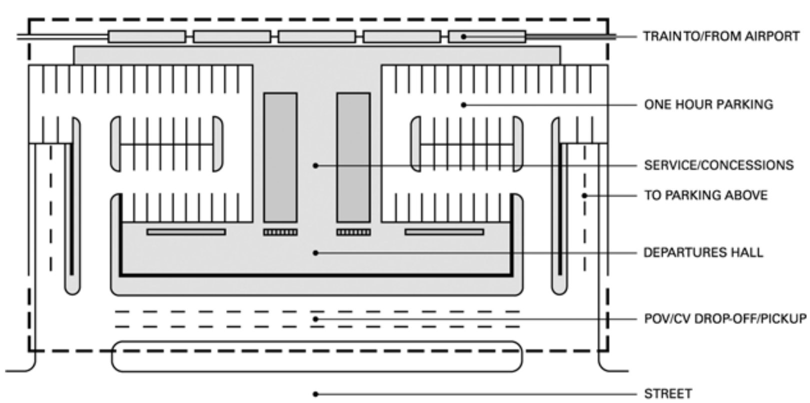

Figure 5-16. RPPF concept example.

Table 5-3. Landside concept example comparison.

Key Considerations	Landside Concept Example APPF	OPPF	RPPF
Physical attributes			
Availability of land	●	●	●
Roadway and parking access control	○	○	—
Availability and configuration of close-in parking	●	○	—
Regional transit connection to airport	○	○	●
Rental car operations	○	●	—
Non-physical attributes			
Facility cost	●	●	●
Constructibility and operational disruption	●	○	—
Availability of PFC funds	●	●	—
Airport bonding capacity	●	●	—
Federal transit funding availabiilty	—	—	●
Airport and regional policies	●	●	●
Ground transportation characteristics	●	○	—
Passenger characteristics	●	●	●

● Attribute is a major consideration
○ Attribute is important but not a major consideration
— Attribute is not a concern

Physical Attributes

Physical attributes of the airport that would affect the selection of a desired future landside concept may include the following.

Availability of Land

The location of available land for facility development would have a direct effect on the type of landside facility that could be developed. For example, a fully developed terminal area may be considered an impediment to constructing a close-in landside facility (APPF), unless the APPF were to be implemented as a retrofit or replacement to an existing facility. However, airports that do not have a close-in parking structure may be candidates for an APPF. Airports with undeveloped land remote from the terminal may find the OPPF concept more desirable. On the other hand, airports with severe land constraints may find that an off-airport RPPF could serve as a potential solution.

Roadway and Parking Access Control

Configuration of the airport's access and parking control system(s) is primarily a design consideration that can be addressed as part of the development of a landside concept; however, the potential effect on access and parking control systems should be considered as part of concept development. An APPF configuration may require integration of the landside plaza (e.g., short-term parking) into an existing parking structure, but require a separate entry and exit that would maintain the integrity of the parking revenue control system.

Availability and Configuration of Close-in Parking

The availability of a close-in parking structure may influence the decision to develop an APPF or an OPPF. In addition, the configuration of the facility would be a consideration with regard to the ability to retrofit an existing structure to provide an efficient passenger pickup and drop-off plaza for POV and CV operations. For example, a low floor-to-ceiling height may limit the size of CVs that would be allowed to serve a plaza. A low ceiling height could also affect lighting, wayfinding, and overall passenger comfort within the structure. An existing structure may also require additional ventilation systems to accommodate the introduction of idling vehicles within the facility. The configuration and spacing of the column grid would also affect the ability to accommodate an efficient curbside pickup and drop-off plaza.

Regional Transit Connection to Airport

The availability and location of existing and future rail transit services may affect the selection of a location for implementation of a landside passenger-processing facility. For example, the integration of a rail station could allow for co-locating services and facilities such as ticketing, bag-check, and concessions more feasibly in an OPPF than an APPF because the latter is likely to be in a more congested area. For those airports where a future rail connection is planned, an RPPF could be co-located with other "non-airport" station facilities to promote use of the rail system and encourage the success of other synergistic retail and concession services.

Rental Car Operations

The type of rental car services currently provided and plans for future expansion could be a consideration for inclusion within a landside concept. For example, providing consolidated rental car facilities within or adjacent to an OPPF could help generate passenger demand that would justify and support the introduction of an APM connecting the OPPF to the terminal.

Nonphysical Attributes

Nonphysical attributes of the airport that would affect the selection of a desired future landside concept may include the following.

Facility Cost

In addition to the construction costs that will vary by option, the capital costs needed to ready the site and to construct the facility would range greatly from concept to concept. For example, the costs would vary significantly depending upon whether the facility is developed on a greenfield site; is a retrofit to an existing facility; or, if an existing close-in facility, would be removed to allow for construction of a new facility. The capital and operating costs of transporting passengers, and possibly baggage, to and from the site via a pedestrian bridge, APM, or transit system would also be a consideration, particularly for the OPPF.

Constructibility and Operational Disruption

The ability to construct a facility in an operational airport environment would be a consideration. The APPF, for example, would likely create greater operational disruptions and airport passenger inconvenience given its location directly adjacent to the terminal building and potentially within an existing parking structure. The OPPF and RPPF, on the other hand, could be constructed at "remote" locations that would conceivably result in fewer construction-related impacts.

Funding Availability

The availability of funding would be a consideration in the development of facilities. Funding sources and availability would vary by airport and by project, but could include airport revenue bonds, PFC revenues, Airport Improvement Program (AIP) grants for certain aspects of the concept dedicated exclusively for airport access, and other federal transit grants.

Airport and Regional Policies

Airport and regional policies pertaining to environmental initiatives may favor the implementation of certain landside concepts and operational schemes designed to reduce roadway congestion, annual vehicle-miles-traveled, and air pollutants. For example, airports with a transit-oriented policy may find the RPPF concept desirable. In addition, regulations and policies in effect at certain airports may limit how the airport can be modified. For example, historical zoning restrictions at Washington Dulles International Airport limit how the original airport facilities can be modified and restrict the development of facilities that would obstruct the view of the airport terminal building.

Ground Transportation Characteristics

The traffic volumes by mode type will help determine the size and configuration of the components of the various landside concepts. Airports with high CV traffic would require landside facilities capable of accommodating these larger vehicles and the passenger volumes associated with them. Airports would also have to accommodate POV traffic and provide access options that accommodate the high volumes and traffic patterns of these vehicles, including those proceeding to parking, to curbside, or to both locations.

Passenger Characteristics

Passenger characteristics will affect how a passenger-processing solution is implemented. Airports serving a large elderly population may be more likely candidates for use of assisted parking spaces or, at a minimum, convenient close-in parking. The proportion of passengers with checked baggage, such as those traveling to leisure destinations, would also affect the locations of ticketing and baggage-check facilities.

CHAPTER 6

Terminal Concepts

A number of passenger processes are grouped under terminal concepts, including those processes that typically occur at or within a terminal building such as checking in with or without baggage, domestic arrivals, bag claim, and the interface with ground transportation services. The relationship of these functions with the dropping off and picking up of passengers is also considered. The innovative concepts described in this chapter include one or more of the innovations described in Chapter 4.

Departures Hall

Traditionally at airports with terminals that serve multiple airlines, the departures hall is generally, but not always, divided by airline in approximate proportion to the number of flights each airline provides and the number of passengers each airline serves. Each airline's space is then subdivided between that space serving first-class and premium passengers and that space serving all other passengers, both of which are served by airline staff. More recently, with the introduction of SSDs for obtaining boarding passes, a further subdivision has developed (see Figure 4-3). The situation in the departures hall is mirrored at the adjoining curbside where passengers are directed to be dropped off and possibly check their bags immediately in front of the relevant airline. These combined circumstances create a number of problems, including periodic overcrowding in the departures hall; the need for passengers, after checking in, to pass by several other airline counters on their way to the SSCP; and curbside congestion.

With the use of CUSS instead of the airlines' proprietary SSDs, the paradigm changes significantly. Rather than each airline providing differentiated services, services could be differentiated for passengers regardless of airline (i.e., a process-based departures hall). This change not only means improved space and staff utilization, but also enables passengers to select their entry point into the building in relation to the services they require. The expanded use of CUSS would also enable services for special populations to be location focused and, therefore, more readily available. Following are four departures hall concepts based on the process-based departures hall innovation.

Main Street Check-In

This concept (see Figure 6-1) demonstrates a layout in which passengers approaching the curbside are offered two choices for entering the building. The first choice would be for prechecked passengers who obtained their boarding passes remotely and who either have no check bags or have previously checked their bags at a bag-check plaza. This point of entry leads directly to the SSCP, completely bypassing the departures hall. This option could account for as many as 60% to 80% of all passengers, depending on whether bag check is available prior to the departures hall. The second point of entry would be for all other passengers. Once inside the terminal building, passengers would be offered three optional services as they proceed in the general direction of the SSCP. The first option would be SSDs, where a boarding pass may be obtained; the second option would be self-service check-in with bag drop; and the third option would be full-service staffed positions.

Advantages/Disadvantages

This concept would be very adaptable in an existing departures hall as conventional baggage take-away belts could be used and additional building depth would not be required. The further advantages of this concept are that it would enable clear and effective curbside separation and a fast-track route for business travelers and that the full-service positions would act as a backup for those who may have difficulty with the SSDs if a help point is not provided.

One disadvantage of this concept would be that passengers who need to obtain a boarding pass and have no check baggage would have the longest walk. Also, since the self-service

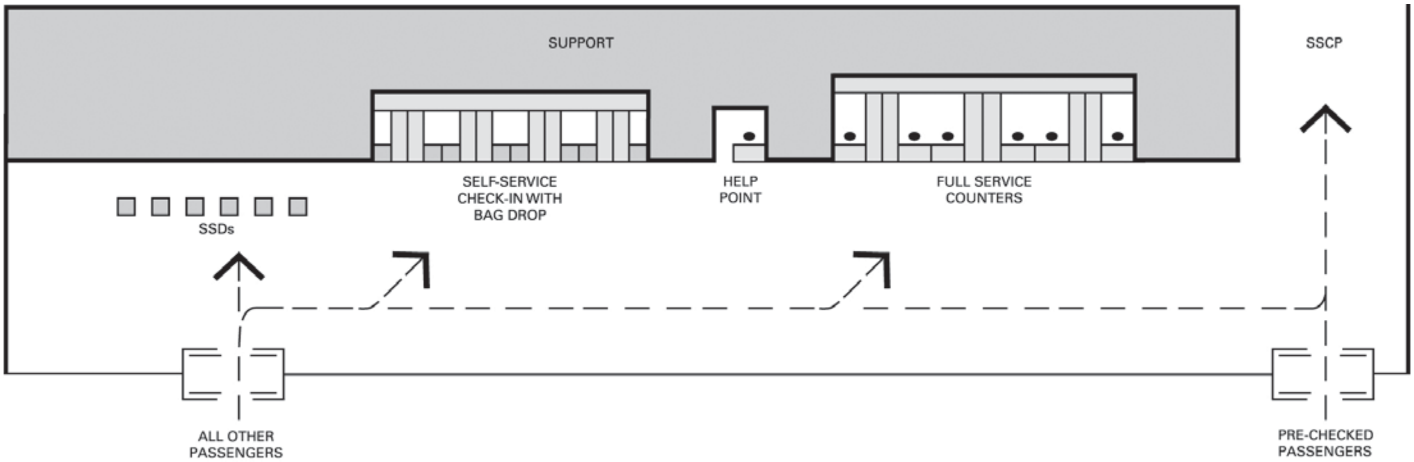

Figure 6-1. Main street check-in.

and full-service positions would not be flow-through, queues could back up into the circulation area. The only major impediment to implementing this concept would be the use of common-use equipment.

Three-Lane Check-In

In this concept (see Figure 6-2), the terminal entry points would be distributed along the curbside frontage according to three passenger categories. The first entry point or "lane" would be for passengers without check bags. This category would include passengers who obtained their boarding passes remotely or who only need to obtain a boarding pass or who may have checked their bags prior to the departures hall. These passengers would proceed directly to the SSCP after obtaining a boarding pass, if needed, at an SSD. A help point would be provided for passengers having difficulty using the SSD. The second entry point would be for passengers with check bags. This entry point would lead to an SSD where passengers could check and tag their own bags. The third entry point would be for passengers who want or need full-service at a staffed position. In this concept, the full-service and self-service bag-check positions would generally be flow-through (i.e., passengers would be able to continue in the same direction of travel rather than turning 90-degrees), which would reduce cross-traffic at the counters; however, this concept could also be developed using a conventional baggage take-away system.

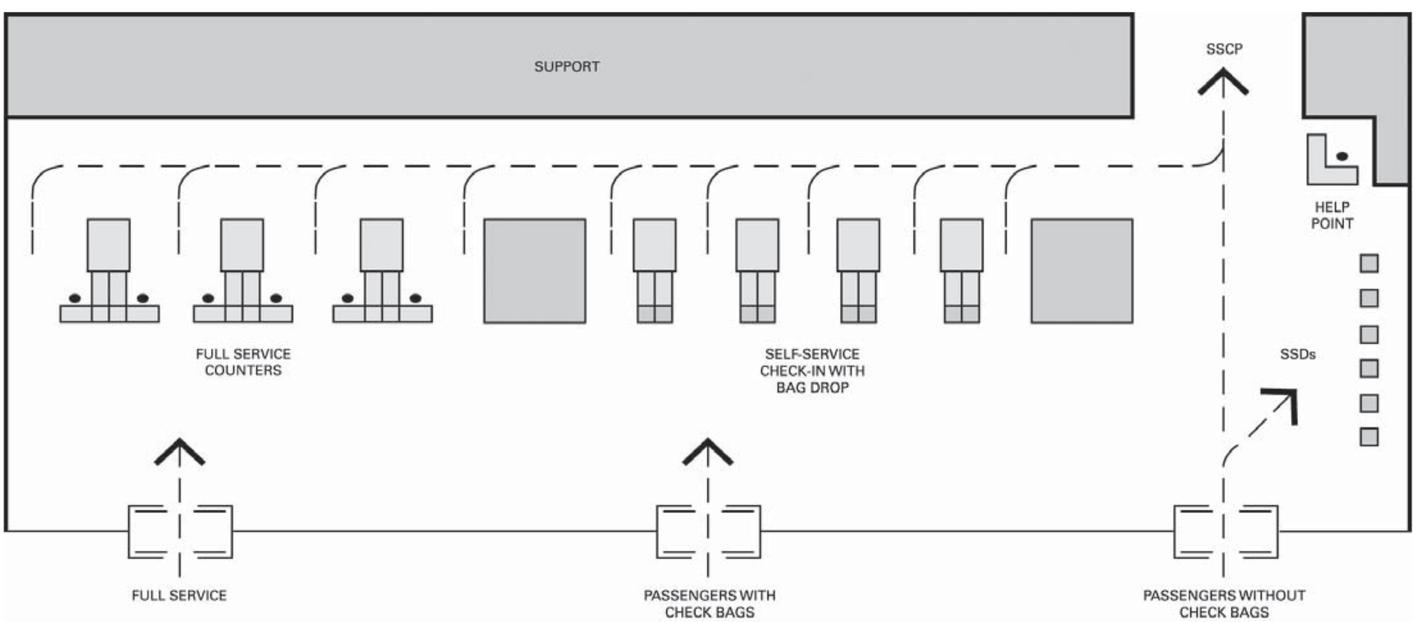

Figure 6-2. Three-lane check-in.

This concept would also be adaptable to most existing terminal buildings, particularly if the conventional baggage take-away system were used. The flow-through option would require more building depth and would also be a more expensive installation not only for the baggage system, but also for multiple floor penetrations.

Advantages/Disadvantages

The advantages of this concept are that it would further separate passengers according to their service requirements, enabling an even greater breakdown of curbside space. This concept would also provide a fast-track route for those passengers requiring little or no service, thus providing the highest level of convenience for the largest share of passengers. The disadvantages of this concept are that agents at the full-service counters would not back up the other positions, thereby requiring a separate help point to deal with passenger problems. Also, in the flow-through configuration, the support area for the agents would be remote from their workstations, which could be considered a negative factor by the airlines.

Three-Stage Check-In

This concept (see Figure 6-3) presents a different approach by providing a centralized entry point for all passengers. Once inside the terminal building, passengers would proceed down a central mall with service offerings on either side, beginning with the minimal service provided by SSDs for boarding passes (Stage 1) to self-service check-in with bag-drop positions (Stage 2), and, finally, full-service staffed counters (Stage 3). Although Figure 6-3 shows a single entry point, it is anticipated that this approach would be replicated at each SSCP. This concept would not typically be adaptable to most existing terminal facilities because of the building depth required. However, this concept has a number of advantages.

Advantages/Disadvantages

The three-stage check-in concept is an intuitive system, with passengers progressing forward and only deviating to avail themselves of a required service. The self-service positions would be prominent, which would encourage their use rather than the more costly-to-operate, full-service positions that would essentially be provided as a last resort. The disadvantages of this concept, as previously mentioned, would be the need for much greater building depth than is commonly available; also, the baggage system costs required for the flow-through positions would be higher.

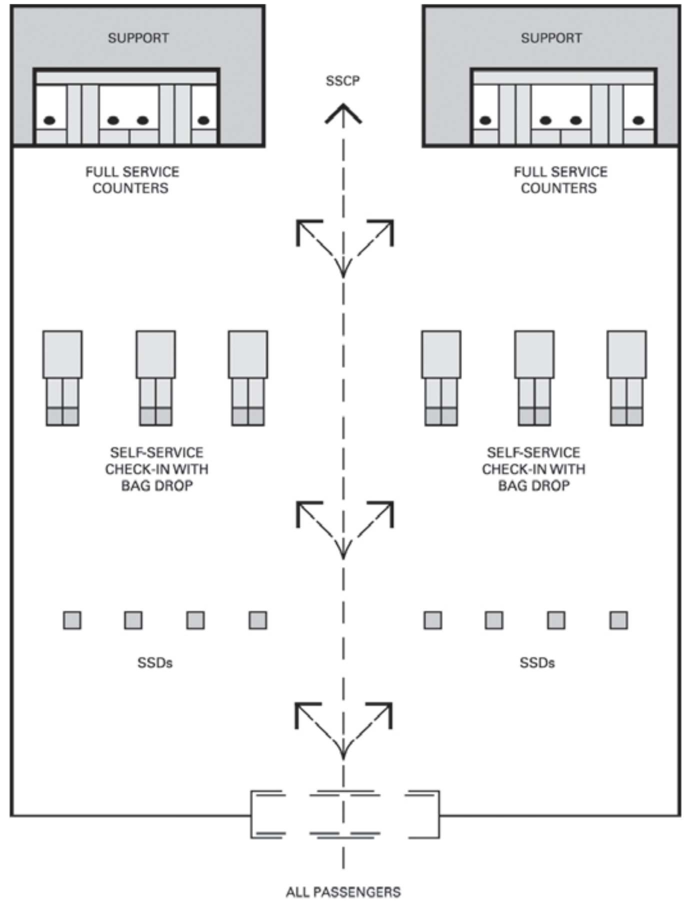

Figure 6-3. Three-stage check-in.

Directional Check-In

This concept (see Figure 6-4) is a variation of the island check-in system commonly found in many European airports. In this concept, passengers would select the least congested entry point and, once inside, would encounter SSDs to obtain boarding passes only, with immediately adjacent self-service check-in with bag-drop positions. The full-service positions would be located behind the self-service positions; however, they would be clearly identified as passengers enter the departures hall. This concept is compatible with many existing check-in halls; however, it would often require relocation of the support area typically located behind the ticket counter.

Advantages/Disadvantages

The advantages of this concept are that services would be presented to passengers in a logical manner and that the layout would also effectively guide passengers in the direction in which they need to proceed. The baggage system would provide economies in that the self-service and full-service positions would share the same baggage take-away belt.

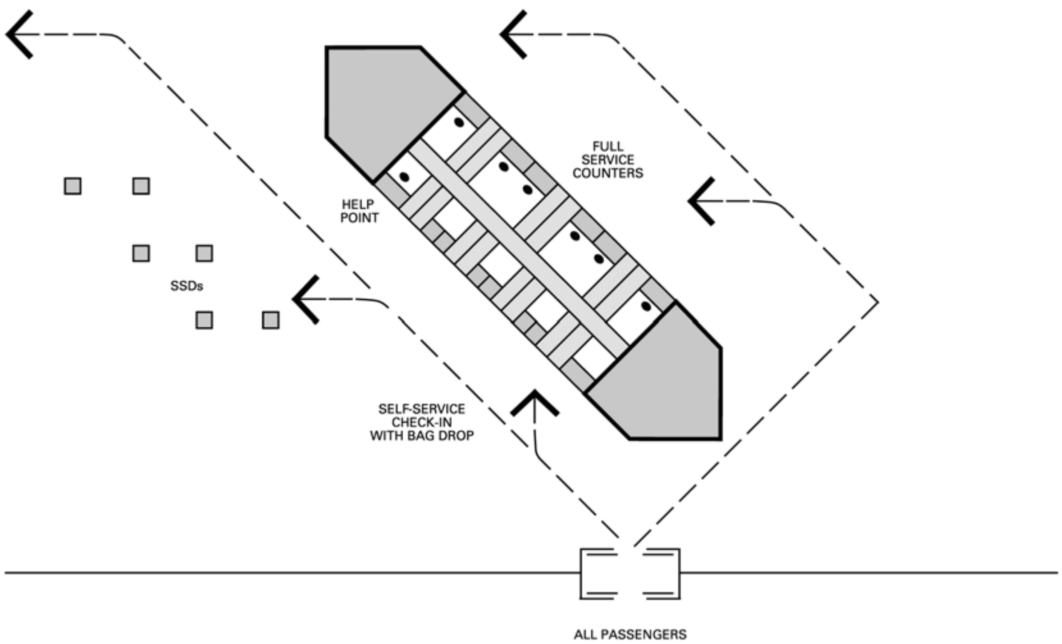

Figure 6-4. Directional check-in.

Summary of Departures Hall Concepts

Each departures hall concept has unique physical and operational characteristics. Some of the concepts, such as the main street check-in, may be more suitable for implementation during a minor renovation while others, such as the three-stage check-in, may only be feasible where new terminals are being constructed. Other characteristics, such as the baggage-screening system and terminal configuration, are major factors when considering one or more of the departures hall concepts. Table 6-1 presents a comparison of the concepts based on several terminal characteristics.

Arrivals Facilities

Historically, the domestic arrivals facilities at many airports have not received the same attention as the departures hall from either a functional or aesthetic standpoint. Baggage-claim halls commonly have lower ceilings and are generally interior spaces with no natural light. This reduced sense of place for passengers has been exacerbated since meeters-and-greeters are no longer able to meet passengers at the gate and passengers are left to wonder where they might meet their waiting parties once they emerge from the secure area. Generally, few, if any, concession amenities are provided in

Table 6-1. Departures hall concepts comparison.

Key Considerations	Main Street Check-in	Three-lane Check-in	Three-stage Check-in	Directional Check-in
Departures hall depth† (< 50 ft)	●	—	—	—
Departures hall depth† (50 ft > 85 ft)	○	●	—	○
Departures hall depth† (> 85 ft)	○	○	●	●
Multi-carrier terminal	●	●	○	○
Single-carrier terminal	○	●	●	●
Single-level terminal	●	—	—	—
Multi-level terminal	●	●	●	●
Adjacent airline support space	●	●	—	—
Re-use of existing baggage system	●	—	—	●
Centralized in-line baggage screening	●	●	●	○
Major renovation	●	○	—	●
New construction	○	●	●	●

● Concept is highly relevant
○ Concept is relevant but not optimal
— Concept is not a consideration
† Departures hall depth is the depth of the space availabe for circulation and check-in functions

domestic arrivals facilities. Once passengers have claimed their bags, the myriad ground transportation offerings are often confusing; once outside the terminal building, passengers must wait to be picked up or wait for a ground transportation service in areas that provide some protection from the elements, such as a canopy, but are generally open on the sides.

Consolidated Domestic Arrivals Hall

The concept illustrated in Figure 6-5 is idealized: all domestic arrivals at a particular terminal would emerge through a well-defined exit into a meeters-and-greeters area similar to that generally provided for international arrivals. Amenities such as concessions would be available immediately adjacent to the meeters-and-greeters area, with improved commercial viability resulting from the funneling of all arrivals through a single point. From the meeters-and-greeters area, passengers would be able to choose either a direct exit from the terminal building if they are not claiming baggage or access into the bag-claim hall where baggage carts would be readily available prior to the claim devices. The devices would be adequately spaced (approximately 60 ft on center) to allow seating between them for elderly and disabled passengers. The claim devices would be flat-plate, whether directly or remotely fed, to facilitate the process for the elderly and disabled passengers who have difficulty lifting baggage over the sill of standard slope-plate devices. High-capacity flow-through elevators would be available as a primary option for passengers proceeding to the garage or other levels of the terminal. Escalators would supplement the elevators, as appropriate. Arrivals lounges, as described below, would be available to enhance the experience of passengers using CVs to exit the airport.

It is not anticipated that this entire arrangement could be adapted to an existing terminal, but rather that individual components could be incorporated as part of general improvements for domestic arrivals.

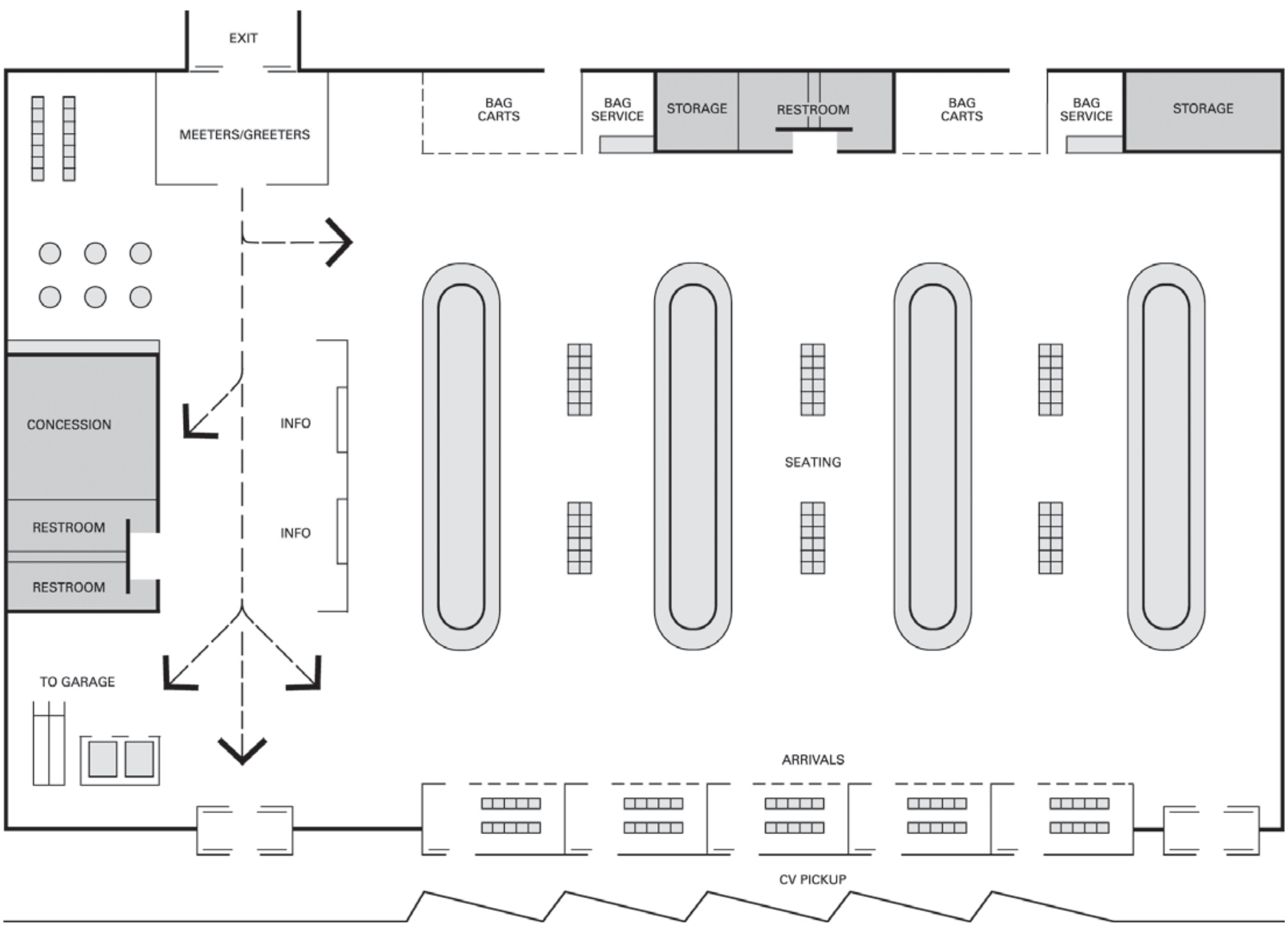

Figure 6-5. Consolidated domestic arrivals hall.

Arrivals Lounge

The arrivals lounge concept (see Figure 6-6) would provide the same types of amenities for passengers waiting for ground transportation services as those amenities departing passengers experience in gate holdrooms while waiting to board an aircraft. Arrivals lounges would address the issues associated with arriving passengers waiting at the curbside for CVs, which include waiting for an indeterminate length of time in less-than-ideal weather conditions and with some safety concerns, especially at night.

In the arrivals lounge concept, passengers who plan to use ground transportation services, after claiming their baggage, would proceed to a seating area designated for the mode of ground transportation desired such as hotel shuttle, rental car shuttle, inter-terminal shuttle, or other modes. Passengers would check in at an SSD for the specific service desired (e.g., a particular hotel shuttle). This process would activate a curbside indicator ensuring that the required vehicle would stop outside the arrivals lounge. Passengers would then wait in the lounge where shuttle status information would be displayed in minutes to arrival, activated by a global positioning system (GPS) device in each vehicle. Audible and visual announcements would be made when the shuttle arrives. The benefits of this concept would include reduced passenger stress, improved passenger safety and security, and greatly improved passenger comfort. A disadvantage would be the cost of providing the space required if such space were not already available in some other use in the terminal. This concept would also require the cooperation and support of the various ground transportation providers.

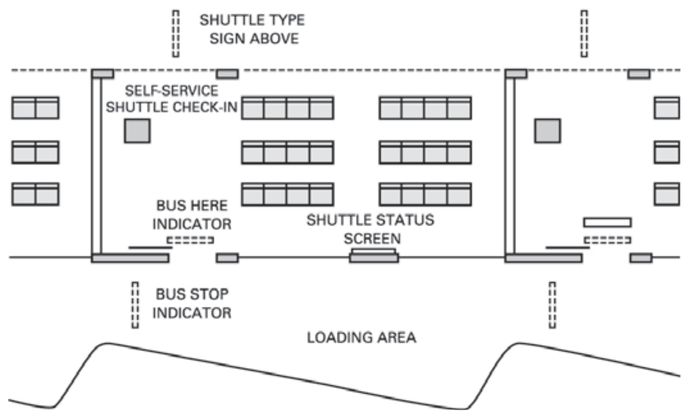

Figure 6-6. Arrivals lounge.

CHAPTER 7

Conclusions

Potential Benefits of Research Results

The innovations and concepts identified and developed through this research project have the potential to provide a number of benefits not only to passengers, but also to airport operators. From the passenger perspective, each of the innovations addresses one or more issues passengers commonly face while transitioning between the different components of the airport terminal landside facilities. More common issues—wayfinding, terminal roadway congestion, waiting/queuing, and safety/security—would be mitigated by rearranging many of the functions that passengers currently experience using best practices from airports in Europe and Asia, as well as by taking full advantage of technologies currently available and operational changes that are likely to take place within the next several years.

The innovations also address the key issues that affect elderly and disabled passengers. Activities such as baggage handling and vertical transitions, identified as being arduous for the elderly and disabled, are addressed by several of the innovations including passenger-processing facilities, bag-check plaza, passenger assistance parking areas, low-profile passenger baggage devices, high-capacity flow-through elevators, and consolidated meeters-and-greeters areas. Addressing issues that affect elderly passengers will become more important as the aging baby boomers become a larger portion of the U.S. elderly population.

The innovations also offer a variety of benefits to airport operators. Landside innovations such as passenger-processing facilities, bag-check plazas, and supplemental curbsides, are intended not only to improve the operational efficiency of the terminal roadways, but also to provide cost-effective opportunities for capacity expansion. Terminal innovations such as the process-based departures hall and self-service baggage check would help to better distribute demand both inside the terminal and along the terminal curbside, as well as increase passenger throughput, which could defer or possibly eliminate the need for a major terminal expansion. Other innovations such as passenger assistance parking areas and consolidated meeters-and-greeters areas may provide opportunities to enhance nonairline revenues by concentrating passengers in certain areas and making concessions opportunities more viable. These innovations may also reduce operating costs by reducing the number of exits from the secure area that have to be staffed or by reducing the need for parking enforcement.

Applicability of Results to Airport Practice

The innovations identified through this research project target some of the most common issues at airports today. While many of the innovations could be immediately applied to airport terminal landside planning and design, some entail crucial factors that require acceptance by airport stakeholders or possibly even a change in **aviation practices**. In addition, several potential impediments could affect implementation of the innovations.

Critical Factors for Acceptance by Airport Stakeholders

Passenger self-tagging baggage is one critical factor that requires both a change in **policy** and subsequent acceptance by airport stakeholders, particularly airlines. Through the research process, discussions held with both airport and airline management representatives indicated that, while there are some operating concerns regarding passenger self-tagging, the concept has the potential to greatly enhance operational efficiency for both entities.

Widespread implementation of common-use technology is a more controversial factor. Implementation of common-use technology to create a process-based departures hall has the potential to yield significant operational benefits for both airports and airlines. However, the loss of brand identity and technical interface concerns are major issues for the airlines that will require acceptance by airline management.

Another critical factor for acceptance by airport stakeholders is the relocation of curbside functions, particularly POV activities, to areas not directly adjacent to the terminal building. However, moving curbside operations to other locations such as a close-in parking garage (creating an APPF) or an OPPF could significantly reduce curbside congestion without the need for major capital expenditures and the operational disruptions typically associated with terminal roadway modifications.

Potential Impediments to Implementation

There are several potential impediments to implementation of the innovations. First, an airport operator's decision regarding how to accommodate the 300-ft rule, as well as the potential for prolonged heightened threat advisory levels, could greatly affect the viability of several innovations, including the APPF and passenger assistance parking area.

Another potential impediment is funding. Several innovations such as passenger-processing facilities or arrivals lounges may require the use of PFC revenues, which have to be approved by the airlines and the FAA. Airline approval may be difficult to obtain if the innovations do not provide additional revenue that could be used to lower the airline rates and charges at the airport. Improvements to passenger levels of service alone are difficult to justify, particularly if the project does not enhance capacity or operational efficiency.

The loss of brand identity is another major obstacle to implementing certain innovations, particularly the process-based departures hall, passenger-processing facilities, and bag-check plaza. To be viable, these innovations require common-use technology to aggregate the demand of several airlines. The result would be a loss of brand identity for individual airlines, as well as the loss of service control. Each airline will have its own opinion on this issue and may choose to maintain its brand identity despite the opportunities for operational improvements and potential cost savings.

Suggestions for Further Research

Two key topics associated with the findings of this research project warrant further investigation. First, passenger self-tagging of baggage requires additional investigation as it has the potential to provide great benefits to airport operators and airlines alike. Topics for inclusion in further research of passenger self-tagging of baggage might include the following:

- Regulations regarding positive passenger identification and baggage screening in countries where passenger self-tagging of baggage is allowed,
- Technologies or methods used to facilitate passenger self-tagging,
- Baggage-handling implications of passenger self-tagging, and
- Passenger-processing rates associated with the different methods for implementing passenger self-tagging.

Another topic for further investigation would be the optimal configuration for the bag-check plaza innovation, as well as the financial feasibility of providing this feature. Key research topics might include the following:

- Determination of the balance between parking spaces and queuing based on the acceptable time in queue;
- Investigation of the most effective layouts;
- Baggage-handling options for various locations (i.e., close-in versus remote); and
- Potential opportunities to generate additional revenue by combining a bag-check plaza with various parking options.

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APPENDIX

Simulation Analysis Results

Computer simulation analyses were performed to estimate facility requirements for selected concepts: (1) a process-based departures hall concept and (2) a landside concept, the bag-check plaza. Rather than develop representative computer simulation models, it was determined that it was more effective to use existing datasets of actual U.S. airports so that realistic estimates could be obtained for the selected concepts. The objectives of the computer simulation analyses were to estimate operational benefits and facility requirements.

Process-Based Departures Hall Concept Simulation Analysis

The three-lane check-in concept was simulated to estimate the check-in position requirements based on the process-based departures hall innovation. This concept consists of three components for departing passengers, using different access points depending on their service requirements:

1. Full-service counters,
2. Self-service bag drop, and
3. Self-service devices.

Objective

The objective of the simulation analysis was to identify the number of check-in positions required for the three components. Both a one-step check-in process and a two-step check-in process were analyzed.

- **For the one-step process,** it was assumed that the self-service check-in and bag-drop operations would occur together as one process. The average processing time was calculated as a weighted average of bag drop only (Internet check-in passengers with bags); self-service check-in with bags; and self-service check-in without bags.
- **For the two-step process,** it was assumed that the passenger would first use the self-service device for check-in, then proceed to a second location for self-service bag drop.

Methodology

Three scenarios were reviewed to show the impact on the terminal of a three-lane check-in facility.

1. The first scenario (or baseline) identifies the number of positions required for each component if each airline maintains dedicated positions. There would be no dedicated self-service bag drop in place for the one-step process (today's environment), while self-service bag drop was assumed for the two-step process.
2. The second scenario identifies the maximum number of common-use positions by type when each airline is assigned check-in positions that vary by demand throughout the day. (This is similar to today's implementation of common-use facilities, where an airline is allocated check-in positions for a block of time to accommodate its flights.)
3. The third scenario identifies the number of positions required for the "process-based" approach, where all airlines would share common positions.

Two datasets of existing airport passenger terminals were used to evaluate the departures hall concept. One dataset (Airport A) is a single concourse within the airport, with three commercial passenger airlines serving just fewer than 2 million annual enplaned passengers. The second dataset (Airport B) incorporated operations by seven commercial passenger airlines forecast to serve just fewer than 7 million annual enplaned passengers.

Assumptions

Airport A

On average, originating passengers arrive at the airport 110 min prior to a departing flight scheduled before 9:00 A.M., and 115 min prior to a departing flight scheduled after 9:00 A.M. Table A-1 shows the assumptions for passenger check-in locations, and Table A-2 shows the average check-in processing time by component.

Airport B

On average, originating passengers arrive at the airport 60 min prior to a departing flight scheduled before 9:00 A.M. and 74 min prior to a departing flight scheduled after 9:00 A.M. Tables A-3, A-4, and A-5 show the assumptions for passenger check-in locations for a low-cost carrier and for other airlines with and without the use of curbside check-in. Table A-6 shows the average check-in processing times by component.

Description of Simulation Models

Airport A

Airport A has an average of 1.6 passengers per group, with an average of 0.9 checked bags per passenger group. In the departures peak-hour, there are 8 departing flights and 566 originating passengers. All three airlines at this facility are

Table A-1. Airport A passenger and baggage check-in locations (source: TransSolutions, LLC).

Type of Positions	Passenger Type	
	With Check Baggage	Without Check Baggage
Full-service counters	26.8%	11.4%
Self-service devices	28.6	36.4
Internet	44.6	52.2

Table A-2. Airport A average check-in processing times by passenger group and location (source: TransSolutions, LLC).

Type of Positions	Average Processing Time (minutes)
Full-service counters	3.4
Self-service bag drop[1]	1.5
Self-service device	2.1
Self-service device + bag drop[2]	1.6

[1] The self-service bag-drop processing time is estimated at approximately 70% of kiosk processing time.

[2] When the two check-in functions are combined at one kiosk for the one-step process, the processing time is a weighted average time for passengers checking-in with and without check bags and passengers with check bags who obtained boarding passes on the Internet.

Table A-3. Airport B passenger and baggage check-in locations for a low-cost carrier (source: TransSolutions, LLC).

Type of Positions	Passenger Type	
	With Check Baggage	Without Check Baggage
Full-service counters	18.8%	13.5%
Self-service device	15.3	39.1
Internet	57.3	41.2
Curbside[1]	8.6	6.2

[1] It was assumed that all curbside check-in passengers would use the self-service devices.

Table A-4. Airport B passenger and baggage check-in locations for other airlines with curbside check-in (source: TransSolutions, LLC).

Type of Positions	Passenger Type	
	With Check Baggage	Without Check Baggage
Full-service counters	20.5%	18.9%
Self-service device	30.9	36.4
Internet	38.9	35.8
Curbside[1]	9.7	8.9

[1] It was assumed that all curbside check-in passengers would use the self-service devices

Table A-5. Airport B passenger and baggage check-in locations for other airlines without curbside check-in (source: TransSolutions, LLC).

Type of Positions	Passenger Type	
	With Check Baggage	Without Check Baggage
Full-service counters	22.7%	20.9%
Self-service device	34.2	39.5
Internet	43.1	39.6

Table A-6. Average check-in processing times by location (source: TransSolutions, LLC).

Type of Positions	Average Processing Time (minutes) [1]
Full-service counters	2.3
Self-service bag drop	1.4
Self-service device	1.3
Self-service device + bag drop	2.4

[1] The combination of a low-cost carrier and other airline processing times.

legacy carriers, with the peak hours occurring at approximately the same time of day.

Airport B

Airport B has an average of 1.3 passengers per group, with an average of 1.1 checked bags per passenger group. In the departures peak-hour, there are 18 departing flights and 2,093 originating passengers. The seven airlines operating at this airport terminal include both legacy carriers and low-cost carriers. One predominant airline has approximately half of the market share at this airport.

Results

Airport A

Under the first scenario, with individual check-in positions allocated to the three airlines on a long-term basis (although each airline may not require the number of allocated positions except during certain periods of the day), nine full-service positions are required for both the one-step and the two-step processes, while the two-step process requires 25% more self-service check-in devices (12 SSDs) than the one-step process (9 SSDs).

Under the second scenario, representing today's common-use environment where check-in positions are allocated by airline throughout the day to meet the airlines' flight schedule and/or hourly passenger demand, there would be a small savings in the number of both full-service positions and self-service kiosks.

Under the third scenario, with a process-based approach, the required number of full-service check-in positions would be reduced to five, a 45% reduction compared with the first scenario; however, the number of self-service positions would remain about the same.

Table A-7 summarizes the check-in position requirements for the one-step process, and Table A-8 summarizes the findings for the two-step process.

Since the three airlines at Airport A all have peak departure hours at approximately the same time, a similar number of self-service devices would be required with the process-based approach as with dedicated facilities (today's scenario). However, there would be a significant (45%) reduction in the number of required full-service check-in positions.

Airport B

Under the first scenario, with individual check-in positions allocated to the seven airlines on a long-term basis (although each airline may not require the number of positions allocated except during certain periods of the day), 17 full-service counters would be required for both the one-step and the two-step processes, while the two-step process would require 15% fewer self-service check-in devices (44 SSDs) than the one-step process (52 SSDs).

Under the second scenario, representing today's common-use environment where check-in positions are allocated

Table A-7. Summary of check-in position requirements: Airport A one-step process (source: TransSolutions, LLC).

Type of Positions	Number of Positions		
	Scenario 1 Positions Dedicated to Each Airline	Scenario 2 Today's Common Use	Scenario 3 Process-based
Full-service counters	9	8	5
Self-service device	9	9	9

by airline throughout the day to meet the airlines' flight schedules and/or hourly passenger demand, there would be a small savings in the number of full-service check-in positions (15 compared with 17 above) and in the number of self-service kiosks (41 SSDs for the one-step process and 37 SSDs for the two-step process).

Under the third scenario, with a process-based approach, only 10 full-service check-in positions would be required—a 40% reduction compared with the first scenario; likewise, the number of required self-service positions would be reduced to 37 SSDs for the one-step process and 28 SSDs for the two-step process. For the one-step process, the requirement for SSDs would be reduced by about 29%, and for the two-step process, the requirements would be reduced by 47% for SSDs and 31% for self-service baggage check.

Table A-9 summarizes the check-in equipment requirements for the one-step process, and Table A-10 summarizes the requirements for the two-step process.

As the airlines at Airport B have different peak departure hours, significant reductions in check-in equipment would be realized in the process-based departures hall. The check-in devices used predominantly by one airline's passengers at one time of day would be used by other airlines' passengers at other times. This sharing of facilities shows that an existing airport departures hall (with dedicated airline check-in equipment) can accommodate a significant increase in the number of passengers by adopting a process-based approach.

Landside Bag-Check Plaza Concept Simulation Analysis

Operations in the bag-check plaza were simulated to estimate the numbers of self-service check-in positions and parking/queue positions required to accommodate passenger demand. The impact on the terminal check-in hall of providing a bag-check plaza was also analyzed.

Methodology

The dataset used in this simulation analysis represents a medium-hub airport with a high percentage of POVs. Existing demand (from 2002) at one domestic terminal was approximately 1,200 peak-hour enplaned passengers on 11 peak-hour aircraft departures. The bag-check plaza was evaluated with different numbers of check-in stations to determine requirements to meet demand. Three scenarios were tested.

Table A-8. Summary of check-in position requirements: Airport A two-step process (source: TransSolutions, LLC).

Type of Positions	Number of Positions		
	Scenario 1 Positions Dedicated to Each Airline	Scenario 2 Today's Common Use	Scenario 3 Process-based
Full-service counters	9	8	5
Self-service device	6	5	5
Self-service bag drop	6	5	6

Table A-9. Summary of check-in position requirements: Airport B one-step process (source: TransSolutions, LLC).

Type of Positions	Number of Positions		
	Scenario 1 Positions Dedicated to Each Airline	Scenario 2 Today's Common Use	Scenario 3 Process-based
Full-service counters	17	15	10
Self-service device	52	41	37

Table A-10. Summary of check-in position requirements: Airport B two-step process (source: TransSolutions, LLC).

Type of Positions	Number of Positions		
	Scenario 1 Positions Dedicated to Each Airline	Scenario 2 Today's Common Use	Scenario 3 Process-based
Full-service counters	17	15	10
Self-service device	15	13	8
Self-service bag drop	29	24	20

Table A-11. Passenger and baggage "first contact" locations (source: TransSolutions, LLC).

Location	Passengers		Baggage	
	Airline 1	Other Airlines	Airline 1	Other Airlines
Curbside	7.3%	17.4%	21.4%	20.1%
ATO	41.1	73.3	78.6	76.6
Kiosk	0.0	5.6	0.0	3.3
Gate	51.6	3.7	N/A	N/A

ATO = Airline Ticket Office; N/A = Not applicable

1. ***Scenario 1:*** *8 bag-drop positions using a 60%/20%/20% split:*
   - 60% of POV passengers with check baggage proceed to the bag-check plaza, then park.
   - 20% of POV passengers with check baggage are dropped off at the curbside first to use full-service check-in, then park.
   - 20% of POV passengers with check baggage park, then use full-service check-in.
   - POV passengers with no check bags park, then 20% use full-service check-in, while the other 80% obtain boarding passes at an SSD or proceed directly to the SSCP.
2. ***Scenario 2:*** *8 bag-drop positions using a 40%/40%/20% split:*
   - 40% of POV passengers with check baggage proceed to the bag-check plaza, then park.
   - 40% of POV passengers with check baggage are dropped off at the curbside first to use full-service check-in, then park.
   - 20% of POV passengers with check baggage park, then use full-service check-in.
   - POV passengers with no check bags park, then 20% use full-service check-in, while the other 80% obtain boarding passes at an SSD or proceed directly to the SSCP.
3. ***Scenario 3:*** *12 bag-drop positions using a 60%/20%/20% split:*
   - 60% of POV passengers with check baggage proceed to the bag-check plaza, then park.
   - 20% of POV passengers with check baggage are dropped off at the curbside first to use full-service check-in, then park.
   - 20% of POV passengers with check baggage park, then use full-service check-in.
   - POV passengers with no check bags park, then 20% use full-service check-in, while the other 80% obtain boarding passes at an SSD or proceed directly to the SSCP.

The process evaluated in the simulation modeling included passengers parking their vehicles in available spaces, unloading their check bag(s), and walking to the self-service bag-drop position to check their bag(s). After check-in, the passengers walk back to their vehicles and drive away to park.

Assumptions

Table A-11 shows the locations where passengers/baggage first come into contact with airline staff for check-in. "Airline 1" is a low-cost carrier with different characteristics than the other airlines. The "gate" location represents passengers who checked-in through the Internet prior to arrival at the terminal. Table A-12 shows the average check-in processing times by passenger class and location. The same processing time distribution was used for the bag-check plaza and curbside check-in.

Description of Simulation Models

The departure peak-hour operations include 11 departing flights with 1,192 enplaned passengers. Four airlines operate at this terminal, including one low-cost carrier. The terminal has an average of 1.4 passengers per group, with an average of 1.3 checked bags per passenger group. Originating passengers arrive at the airport on average 90 min prior to departure for flights scheduled before 8:30 A.M. and 110 min prior to departure for flights scheduled after 8:30 A.M.

Table A-12. Average check-in processing times by passenger class and check-in location (source: TransSolutions, LLC).

Passenger Class/Location	Average Processing Time (minutes)	
	Airline 1[1]	Other Airlines
First/business class	–	2.6
Coach	2.3	3.7
Curbside	3.2	3.2

[1] Airline 1 is a low-cost carrier and does not offer first/business class check-in.

Table A-13. Transportation mode distribution (source: TransSolutions, LLC).

Transportation Mode	Percent
Private car	77.1
Rental car	14.4
Taxicab	2.3
Limousine	1.0
Door-to-door van	2.8
Hotel/motel courtesy vehicle	2.3
Chartered bus	0.1

Table A-14. Private vehicle first point-of-contact locations (source: TransSolutions, LLC).

Location of First Point of Contact	Percent
To the curb, then exit	48.9
To the curb, then off-airport parking	0.8
To the curb, then parking or rental car return	2.9
To parking or rental car return	47.4

Table A-15. Private vehicle parking facility distribution (source: TransSolutions, LLC).*

Parking Facility	Percent
Terminal	67.5
Airport remote	18.0
Off-airport	2.3

*The remaining 12.2% are private vehicles that do not utilize on-airport parking facilities.

Table A-16. Average Vehicle load/unload times at the bag-check plaza (source: TransSolutions, LLC).

Bag-check Plaza	Average Load/Unload Time (seconds)
Private vehicle load time	96.5
Private vehicle unload time	76.2

Table A-13 shows the transportation mode distribution used in the model. Table A-14 shows the distribution of the first point-of-contact locations for POVs. Table A-15 shows the distribution of parking facilities used by passengers that arrive at the airport by POV and park. Table A-16 shows the distribution of private vehicle load and unload times at the airport. This distribution times will be used only for passengers using the bag-check plaza.

Results

Table A-17 shows the total time passengers would be in the bag-check plaza, the maximum number of parking spaces needed for vehicles in the bag-check plaza, the number of check-in positions, and the average numbers of vehicles per position for the three scenarios. The analysis shows that increasing the number of positions by 50% (from 8 to 12 positions) would reduce the time spent in the bag-check plaza and the number of vehicles waiting in the queue.

Scenario 1 would not provide the number of bag-drop positions to effectively meet demand. Scenarios 2 and 3 would both meet demand, providing acceptable times for this check-in process. Of the 6.6 min, on average, passengers would spend in the bag-check plaza, processing accounts for just over 6 min—unloading from the vehicle, walking to the bag-check position, checking in, walking back to the vehicle, and loading into the vehicle. Only 30 sec of the average bag-check plaza time were spent waiting or queuing.

Inside the terminal check-in hall, the maximum passenger queues would be reduced by 50% or more. Meanwhile, the traditional curbside check-in queues would be similarly reduced. To serve the 1,200 enplaning passengers with 77% in POVs, 8 bag-check positions would be adequate if 40% of the POVs use the bag-check plaza. If the bag-check plaza use increases to 60%, then 12 positions would be required. For each check-in position, approximately four or five parking spaces should be provided for vehicle staging.

Table A-17. Bag-check plaza summary (source: TransSolutions, LLC).

Scenario (Share of passengers using bag-check plaza/number of positions)	Time in Bag-check Plaza (minutes)			Maximum Parking Spaces Needed	Number of Positions	Average Vehicles per Position
	Average	95^{th}%	Max.			
Scenario 1 (60%/8)	24.24	53.0	72.2	146	8	19
Scenario 2 (40%/8)	6.6	11.7	21.7	36	8	5
Scenario 3 (60%/12)	6.6	11.7	24.3	51	12	5

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation